Interpreting Tradition in the Digital Age

Can the qualities of a 1930s to 1950s archival printed fabric be captured utilizing digital technology?

Grace Smith

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Heriot-Watt University

School of Textiles and Design

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ABSTRACT

The development of printed textiles has taken on considerable change from its analogue European inception in the 18th Century to the digital mass market of the 21st Century. The introduction of digital textile printing has revolutionised the industry in the last decade, providing scope for unlimited design options and versatile production units. However, to coincide the authenticity of traditional methods such as screen-printing are being lost or replaced. Fortunately, archival resources provide opportunities to witness first-hand our past traditions and heritage.

The intention of the research was to explore the possibilities presented by archive and digital technology utilization. The research employed archival resources to identify the key characteristics of 1930s to 1950s printed fabrics. The era was selected because of the significant development of process with the introduction of screen-printing for industrial application. In addition, designers injected colour, texture and pattern into their textiles in response to the austerity of economic downturn and the onset and conclusion of war. Consequently, this encouraged a new design aesthetic supported by industry journals such as *The Ambassador* and particular manufacturers of the time. A matrix of characteristics was devised via a case study of selected fabrics. The collected data was developed further utilizing current textile design software and hardware resulting in a series of test samples exploring the identified characteristics. Further analysis via a questionnaire and interview with an industrial printworks provided understanding to the opportunities presented from a commercial and industrial context. In conclusion, the research will investigate whether the qualities of archival printed fabrics can be captured utilizing digital technology. The research will attempt to determine that the preservation, reinterpretation and application of historical artefacts via digital means could be a tool to aid the preservation of traditional fabric making methods.

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DECLARATION STATEMENT

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CHAPTER ONE - INTRODUCTION

1. Project Introduction

The research demonstrates an exploration of the potential of archive utilization and digital technology to capture traditional textile print methods from archive fabrics. The development of printed textiles has taken on considerable change from its analogue European inception in the 18th Century to the digital mass market of the 21st Century. The researcher intended to establish whether it is possible to capture characteristics inherent of an analogue process via current methodology. Essentially, *can the qualities of a 1930s to 1950s archival printed fabric be captured utilizing digital technology?*

The introduction of digital technologies has revolutionised the textile industry. The development of digital printing onto fabric and design software packages has provided the designer the opportunity for *uninhibited thinking* (Kamat and Phadke, 2014b). The prospect for unlimited colours and a high level of detail provides unlimited design options. However, Bowles and Isaac (2012) highlight that even though a rich design of layered imagery can be achieved, the qualities associated with some methods of traditional printing are lost through the process. Many designers have tried to find ways of re-establishing *authenticity* by reintroducing traditional methods. However, the researcher sought to utilize their own expertise to establish if the qualities of traditional print methods could be captured and reintroduced through digital methodology. The researcher perceived an opportunity to incorporate personal expertise of screen-printing and characteristics of traditionally printed fabrics from the 1930s to 1950s whilst establishing digital skills. Ultimately attempting to interpret tradition in the digital age, establishing an authenticity of the digital process through printed textiles past. In order to accomplish this, the utilization of archival resource was key.

Accessing our past can come in many forms, from stories passed down through the generations, television, libraries, museums, national monuments and the internet. All these resources provide a gateway to furthering our understanding of history. However, one source feeds into all these research avenues, the archive. These facilities can provide *hands-on* experience (Marcketti *et al.,* 2011) of our *national*

memory (Featherstone, 2006) and in this instance, our textile heritage. The tangible nature of the accumulated artefacts within the archive will provide clues, crucial to the investigation. Ultimately preserving these characteristics for future generations and allowing designers and educators to utilize them to recapture the authenticity of traditional print processes. The 1930s to 1950s era was chosen because of the significant development of process with the introduction of screen-printing for industrial application. In addition, designers injected colour, texture and pattern into their textiles in response to the austerity of economic downturn and the onset and conclusion of war.

The research problem focusses on if it is possible to devise a methodology that will identify the characteristics of a fabric from the defined era utilizing archival resource. Followed by developing and utilizing digital tools and applications to recreate the defined characteristics.

1.1 Aim and Objectives of the Project

The aim of this thesis is to investigate the potential of archival utilization and the application of digital technology in the capturing of traditional print qualities. For this investigation, archival utilization is defined as having direct access to artefacts in storage facilities (Archives) and purchased resource. Subsequently employing the gathered data to inform the investigation. The application of digital technology is characterised as both the implementation of digital design software and digital textile printing hardware.

The objectives of the investigation were;

- Evaluate skills of designing and fabric printing from 1800 to modern day with focus on defined (1930s-50s) era and examine the relationship with current practise

- Identify how scholars, educators and designers have utilized archives within their design practise

- Investigate copyright issues in relation to intended project and the use of archival fabrics for educational and commercial purpose

- Identify the textile characteristics and aesthetics of a printed 1930s – 1950s fabric by conducting analysis and interpretation of archival and historical

artefacts

- Assess textile digital technology possibilities in the recreation of key characteristics of a 1930s to 1950s printed fabric
- Create and analyse a series of experimental fabric samples focusing on developed fabric characteristic criteria matrix
- Establish the benefits of utilizing archival fabrics to textile education and industry

1.2 Thesis Outline

Chapter 2 – Literature Review

Present a review of the literature establishing the skill of fabric design and printing from 1800 to modern day with focus on 1930s to 1950s era and current practise. Identify different approaches to archive utilization and the issues surrounding copyright.

Chapter 3 – Research Methodology

Identifies suitable methodologies for accomplishing the research question

Chapter 4 – Findings

Discusses the identification of textile characteristics and subsequent assessment of digital processes in the recreation of characteristic criteria. Subsequent analysis of experimental fabric samples via a questionnaire and further understanding accumulated through an Interview.

Chapter 5 - Conclusion

Offers a project conclusion as well as identifying opportunities for further research and development.

CHAPTER TWO – LITERATURE REVIEW

2.1 Introduction

The research project and thesis comprises investigation with regard to capturing the qualities of archival prints utilizing digital technology. To achieve a broad insight into historical printed textiles, current digital printing technologies and archival utilization, a preliminary review of literature will be undertaken, which will inform further investigation. The review will establish the importance of printed textiles throughout history to the industry, with particular focus on the 1930s to 1950s and their continued utilization, as well as current technological developments. In addition, establishing the significance and limitations of utilizing archival research in the preservation and re-thinking of textile design in current practise. The next section will cover the origins of textile printing and its subsequent adoption in Europe as a method to introduce colour and design to a fabric.

2.2 History

2.2.1 Origins of printing on textiles

According to Miles (2003), in the book *Textile Printing,* fabric printing began life as an art form. It was a versatile way of transferring an image to a piece of fabric. Riello (2010), Robinson (1969) and Montgomery (1970) mention wood block utilization in China and India as early as the 10th Century to create textiles. Whereas, authors such as Carden (2011) and Russell (2011) argue evidence of textile printing in Egypt approximately 4000 years ago. Followed by developments in Japan, known to use stencil techniques on kimono fabrics (Campbell Kuo cited by Lengwiler, 2013). However, the majority of early European knowledge was gained through trading with the Indian subcontinent (Miles, 2003), where wooden blocks were utilized to print chintz in a variety of techniques including bleaching and resist printing (Montgomery, 1970). As Riello (2010) states, the climate and location provided optimum conditions for textile printing to flourish.

Riello (2010) argues there were two ways the knowledge gained in the Indian subcontinent reached Europe. The first was through the travelogues of European adventurers. For instance, George Roques wrote extensively on the production of textiles in India during the latter half of the 17th century. The manuscripts were

unearthed in Paris in 1966. (Schwartz cited in Riello, 2010, pp.12) The other was via the migrating population of Armenia, after the destruction of their homeland in the 17th Century. They would travel throughout Asia and Europe subsequently establishing print workshops with local artisans.

Robinson (1969) claims the appeal and demand for Indian chintz in Europe during the mid to late 17th Century witnessed an increased pressure on Western printers to create imitations. As Miles (2003) states Europe's fascination with textile print encouraged the effort to find faster methods to produce better quality textiles to meet growing demand. India may have provided the theory of printing and dyestuffs, but Europe would provide the preference for mechanical tools.

2.2.2 The Introduction of Copper Plate and Roller Printing to Europe

Miles (2003) claims European artists discovered the possibilities of reproducing pictures from an engraved metal plate in the 15th century. Later in 1752, Francis Nixon of Dublin modified the process to print textiles (Robinson, 1969). The intaglio technique allowed for larger repeat units and greater detailed designs (Montgomery, 1970; Briggs-Goode, 2013). The increased cost due to requirements of skilled artistry and materials did not deter its adoption. As Montgomery (1970) comments increased production speed allowed for larger amounts of fabric and faster delivery to market.

Tierney (2017), Miles (2003) and Robinson (1969) all state Thomas Bell's copper roller printing machine a most notable invention in 1783. The machine involved copper cylinders rather than flat plates and revolutionised the industry at the time. Production of printed calico in Britain increased significantly, as Miles (2003) affirms. Between 1796 and 1851, manufacture increased from thirty million to six hundred million yards annually. As Tierney (2017) reports, increased production and the introduction of synthetic dyes flooded the market with gaudy, cheaper mass-produced textiles.

Subsequently, the establishment of the Arts and Crafts Movement at the beginning of the 20th Century (Chrisman-Campbell, 2013) combined with the cost of engraving, machine set-up and unsuitability for small-scale production (Tierney, 2017)

instigated the demand for an alternative option. This materialised in the form of screen-printing.

2.2.3 Screen-printing

There is serious debate over the origins of screen-printing. Many of the early publications such as *Silk Screen Methods of Reproduction* (Zahn, 1930) and *50 years of Screen Process Printing* (Fossett, 1956) state its origins to Egypt and China. Zahn comments;

> *"The method of reproducing designs or lettering by means other than by hand dates back to the early Egyptians. Later the Chinese made tapestries and wall decorations by the method now known as the silk screen method"* (1930, pp.13)

However, Biegeleisen and Busenbark (1938) argue that evidence cannot be found to substantiate Egyptian or Chinese origin. They believe the first screen-printing techniques to have originated in Japan. They mention the *Japanese Stencil Technique* in their book;

> *"A layer of hair was laid in crisscross fashion between two stencils…The hair held the centers of the design in place, thus, in part, performing the function which is filled by the silk screen"* (1938, pp.2)

Subsequently, Lengwiler (2013) reasons that many publications have *'blurred'* the distinction between Asian techniques and the screen-printing process known today. Whereas Japanese stencil work may have played a minor role in textile finishing, many historical interpretations eventually become fact if they are written about enough. What is known is that Samuel Simon of Manchester, took out the first patent for screen-printing in 1907 (Robinson, 1969). Before this, screen-printing had been utilized briefly in the 19th century to reproduce paintings onto paper and there had been a niche market for silks printed in France (Mackenzie, 1938 pp.42, cited by Robinson, 1969).

Whereas, in Britain, as Chrisman-Campbell (2013) discusses, it would be influential people from the Arts and Crafts Movement that would appreciate the possibilities of the process at the turn of the 20th Century. Influential figures including William Morris and Lazenby Liberty (Founder of Liberty & Co.) would oversee the

reintroduction of hand rendered techniques such as block printing. In addition to newer processes such as screen-printing. The Movement saw it as an *'antidote'* to the many machine made textiles and aniline dyes born from the Industrial Revolution (Chrisman-Campbell, 2013).

However according to Lengwiler (2013), the Americans saw the industrial potential for screen-printing first. The American John Pilsworth saw the possibility for producing banners for the United States Army in 1915. In the same year, the *Selectasine Company* was founded in San Francisco (Lengwiler, 2013) They created a photo-sensitive emulsion that could be utilized to create photo-imaged stencils (Covey, 2016). A version of which (diazo powder) is still in use today. Followed by filing a patent for multi-coloured printing from a single screen in 1915 (Lengwiler, 2013). By 1918, a milling company in Britain had obtained the patent rights to *Selectasine*, establishing *Selectacin* in London that same year (Hobby, 1997).

The majority of the screen-printing innovations during this period were catered towards the signage industry (Zahn, 1930; Biegeleisen and Busenbark, 1938; Lengwiler, 2013). However, the versatility of the process saw its adoption for many purposes. As Zahn comments;

"It [screen-printing] is being used to a great extent by manufacturers of toys, novelties, wagons and industrial and agricultural machinery of all kinds…it is also used for printing dress silks, fabrics, etc…Velvet drapes are frequently printed with the silk screen process, as are bridge covers, card tables, gaming cloths, etc…Women's felt hats are a recent addition" (1930, pp.9-10)

As Ross, Romano and Delgado (1990) comment in *The Complete Printmaker*, screen-printing became a successful addition to the industry because it was economical and allowed designers to utilize finer-lined images and brighter colours.

Breward and Wilson (2012) in the book, *The Ambassador Magazine*, state textile screen-printing began its rise to prominence in the United Kingdom in the 1930s. Initially with methods performed by hand developing to semi-automatic options by the end of the decade. This is explored further in the next section.

2.3 Technical Development of screen-printing during 1930s to 1950s

Fiell (2000) observes that the 1930s were transformative years, which witnessed mechanisation and technological advancement. The introduction of telephones, wireless and aeroplanes led to a sense of internationalism. This allowed for simpler and faster knowledge transfer on a global scale. However, as Fiell (2000) and Robinson (1969) also remark there were still difficulties, which hindered the print industry during this period. The Great Depression in America and a general economic downturn in Europe caused a reduction of sales and shrinkage of the market. This led to a more competitive marketplace as manufacturers struggled to remain buoyant. However, this did permit more economical processes such as screen-printing to carve out a niche.

Unfortunately, the industry did not have much time to capitalise on the developments. By the end of the 1930s, the *Second World War* commenced and this halted the majority of development in the Industry. As Bosker *et al.* (1992) mention, textile manufacturers were expected to produce the necessary goods for the war with all their able workers sent off to fight. In addition, supplies of wool and cotton fell to 20% of pre-war years. As Gardiner (2005) comments, the Government introduced the rations scheme in 1941 to counteract the concern that the rich would purchase all available clothing and household items, leaving nothing for the poorer consumer. By the end of 1943, *'Utility'* clothing and furniture edicts necessitated less design options for the consumer (Andrews and King, 2014). As Hinchcliffe (1989) and Fogg (2013) report, restrictions on printed cloth included a maximum of five colours and small repeat options. Consequently, the abolishment of controls in 1952 (Attfield, 1996) came as a huge relief to the industry.

Peat (1993) alludes to a period of revolutionary development in British textile design as a revolt against the austerity of the war years. Both Bosker *et al.* (1992) and Hinchcliffe (1989) note that the consumer had a *new lease on life*. This fresh attitude coincided with the introduction of a fully mechanised version of flatbed screen-printing in the 1950s (rotary screen-printing would revolutionise the industry in the 1960s). Breward and Wilcox (2012) note that this allowed manufacturers (including David Whitehead, Edinburgh Weavers and Bernard Wardle) to provide high class

printed linens to an industry obtaining the best value from materials in short supply after the war.

An article in a March 1958 issue of Design Magazine reported:

"After much experiment with relatively high priced hand screen prints, many of them by well-known artists, (David) Whitehead's now offer to the mass market the first range of machine screen-prints…machine screen printing is not new in itself, but this application of the technique to furnishings in a major range is a most important British development"

(Peat, 1993, pp.16)

The transformative attitude evoked after the Second World War witnessed great change in the British people and subsequently the textile industry. This change can be seen in the trends during this period, which will be explored further below.

2.4 Printed Textiles – Aesthetics and Design

2.4.1 1930s

The authors, Boydell (1996) and Potvin (2015) have written extensively on 1930s textile design. Along with Douglas (1997), Fiell (2000) and Battersby (1971), they proclaim the rise of *Modernist* tendencies during the first half of the decade, which had started in the 1920s. Fiell (2000) comments the mood of the era had changed from the *Romanticism* to *Rationalism* in decorative arts. The *'craft ideal'* advocated by Morris et al. at the turn of the century was being replaced by industrial methods of production. The Modernist movement exemplified by *all white schemes* advocated by interior decorators, such as Syrie Maugham (Battersby, 1971; Potvin, 2015) witnessed very little space for additional pattern, were seen as an antidote to decorative excess of the Victorians and Edwardians (Potvin, 2015). However, Boydell (1996) reports several manufacturers (including Donald Brothers and Wardle's) had turned to commercial studios and designer-makers instead of their *in-house* designers in an attempt to inject *interest* back into the minimalist interiors advocated by Rationalist ideals (Fiell, 2000). Designers such as Marion Dorn and Allan Walton provided an *injection* of colour, texture and motif back into the stark interiors of the time. Whereas Dorn's stylized figurative imagery and geometric stripes and triangles (Boydell, 1996) in a colour palette of browns, beiges and creams

epitomised the modernist trend, Wardle believed his textiles should add *colour* to the *'increasingly anaemic domestic landscape'* (Potvin, 2015, pp.26). Boydell (1996) reports a variety of textile substrates being utilized including *chenille*, *twilled cotton* and *linen,* all denoting a sense of different textural qualities. Potvin (2015, pp.29) clarifies that Walton believed the *'essence of the modern British interior was one predicated on sensory activation, one qualified to stimulate both sight and touch'.*

The minimalist ideals had started to fade by the end of the decade. Potvin (2015) mentions William Morris, Duncan Grant and Edward Bawden providing *'decorative character'* and *'magnificent specimens of printed linens'* (pp.28). In addition, Reed (as cited by Potvin, 2015) emphasises *'satins, finely woven cottons and linens'* (pp.29) as being durable and absorbing the colour properly during this time.

2.4.2 1940s

By the 1940s, screen-printing was providing versatility that copper roller printing could not. Hinchcliffe (1989) highlights its importance in alleviating pressure on the weave industry, when there were constraints on the availability of materials during and after the Second World War. Whereas for the designer as Rayner *et al.* (2012) reports it provided freedom and spontaneity whilst retaining the nuances of mark-making and textural brushwork. Breward and Wilcox (2012) emphasise a key trend for tweedy fabrics, a textural quality easily obtained through screen-printing. A feature in a 1948 copy of The Ambassador Magazine noted:

> *"Close attention is paid to texture and much of the charm of these new printed effects depends upon the care which has gone into the weaving of the ground fabric"*

(As cited in Breward and Wilcox, 2012, pp.149)

Fogg (2013) highlights the establishment of *The Colour, Design and Style Centre* in 1940 and *Britain can make it* exhibition (1946) as introducing the design talents of artists such as Graham Sutherland, John Piper and Vanessa Bell into the interiors of the British public. As Breward and Wilcox (2012) state, designs such as Sutherland's *Rose* design (Figure 2.1) encouraged the industry and public to adopt a new design aesthetic.

Bosker *et al.* (1992) and Rayner *et al.* (2012) emphasise rebuilding after the war had led to a domestic focus with print designers supported by a limited group of manufacturers and brands, including David Whitehead, Liberty & Co. and Heal & Sons Ltd taking the opportunity to break past traditions. This provided more transformative, experimental and progressive options for the new world.

Figure 2.1 Rose Design by Graham Sutherland (Breward and Wilcox, 2012)

2.4.3 1950s

The *Festival of Britain* in 1951 (Hinchcliffe, 1989) and *Painting into Textiles* exhibition in 1953 (Rayner *et al.*, 2012) heralded the advent of *artist-designer* textiles, created by talented individuals from across Europe. As Breward and Wilcox (2012) describe, bright, airy and free-form patterns designed by Lucienne Day (Figure 2.1), Barbara Brown and Terence Conran (Appendix C pp.176-178; D pp.179-186) would epitomise the style of the era. These exhibitions were passionately supported by *The Ambassador Magazine* (also known as *International Textiles* (Rayner *et al.*, 2012)). Breward and Wilson (2012) confirm it presented an optimistic, defiant picture of the textile industry throughout its circulation. A 1952 edition noted:

"The still, objective sight of the cluttered up and immobile Victorian room has given place to light and air, grace and pace. Colour has itself contributed to motion and the breaking up of texture has provided not only new patterns, but provided the movement that our post war eyes demand"

(Cited by Hinchcliffe, 1989, pp.10-11)

As Fogg (2013) states, there was no place for lavish, nostalgic or grandiose design in post war Britain. The ravaged country required a fresh outlook, which was delivered in part by the textile print industry. Vitality in colour and idiosyncratic imagery inspired by contemporary life, scientific progress, modern art and new consumerism were key trends in the 1950s (Fogg, 2013). These contemporary designs printed in fresh, lively colours on sturdy cottons, linens and rayons (Hinchcliffe, 1989).

Rayner *et al.* (2012) states that not all manufacturers were producing *radical* designs during this time. Boydell (1996) highlights *classicism* never going out of style, with Battersby (1971) confirming that there would always be an appreciation for 18th and 19th century floral designs throughout the period. However, in a 1951 issue of The Ambassador, the editor observed:

"...we see that manufacturers who seek a successful design policy are bold, discerning, positive and successful"

(Breward and Wilcox, 2012, pp. 152)

Hinchcliffe (1989) emphasises that by the mid-1950s, designers were moving away from 'spindly lines juxtaposed with flat areas of colour' in anticipation of larger scale architectural patterns of the 1960s.

The support of manufacturers, retailers, and the consumer established the 1950s as a significant period of pioneering design and manufacture for printed textiles. So much so that the industry still capitalises on the era in current design, explored further below.

Figure 2.2 Calyx Design by Lucienne Day, 1951, Heal and Son Ltd.

2.4.4 The continuing influence of 1930s to 1950s design after the Millennium

Novack and Mustafa (2004), in their article *How Retro Can You Go?* proclaim:

'Meet the new face of design. It's friendly, whimsical, durable and, it turns out, looks much as it did in the 1950s'

They argue that the 1950s hold a special place in people's imagination because of the transformative powers of everyday products. The world is currently threatened by terrorist attacks and sluggish economies. Françoise Serralta of Peclers Paris, an international trend forecasting company, argues that this has *'helped fuel the thirst for nostalgia'*. Coupled with a return to a handcrafted aesthetic established by the rise of *Etsy* and *Not on the Highstreet* (Henderson, 2015) has led to a *'return to warmer, more emotional design'* of the 1950s (Novack and Mustafa, 2004).

Companies such as Maharam in America and Classic Textiles in the United Kingdom have released collections of textiles, reproduced from their 20th Century

originals. Maharam (www.maharam.com), an interior textile company established in 1902, developed *Textiles of the 20th Century* (Figure 2.3) at the turn of the Millennium. They reproduced designer fabrics of the last century, meeting modern performance requirements and '*ensuring their on-going legacy'* (Maharam, 2004). A few years later, The Centre for Advanced Textiles (CAT), created *Classic Textiles (www.classictextiles.com).* The company accurately recreates textile designs by Lucienne Day and Robert Stewart (Figure 2.4) amongst others. The fabrics are sold via their website with specialised products developed for the Living Union brand and other independent selling events and exhibitions (Britt *et al.,* 2014). In the past fifteen years, brands such as Habitat (Jackson, 2010b) and Marimekko (Light, 2014) have reissued designs from the era.

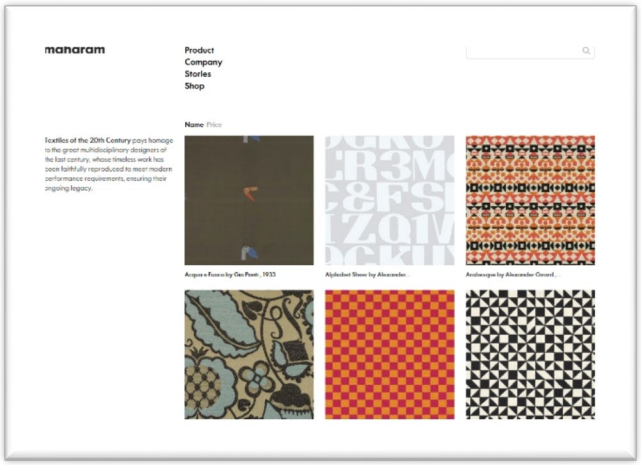

Figure 2.3 Maharam Website showcasing Textiles of the 20th Century

Figure 2.4 Classic Textiles Website advertising Robert Stewart's designs

Serralta (Novack and Mustafa, 2004) perceives nostalgia as *'essential to the evolutionary process of style and design'*. It is clear that the pioneering design developments of the 1950s have been influential into the 21st Century. The passion and ingenuity of the age has seeped into the current aesthetic. Ultimately, its lasting appeal must be a clear sign of how revolutionary the era was in both technological and design development.

2.5 Digital Textile Printing

In the 21st Century, digital technology has become ubiquitous with printed textile design. As Nimkulrat *et al.* (2016) state analogue processes such as block, roller and screen-printing revolutionised the industry previously. However, currently it is the turn of digital imaging and digital textile printing to become an integral part of the textile print process and industry.

Tyler (2005) explains that textile digital printing deposits dye on the surface of a fabric. It is a non-contact technology depositing droplets of liquid ejected through micro-jets (print heads) precisely impacting a substrate to create an image (Malik *et al.* 2004). Ujiie (2006) and Morales (2011) highlight the requirement for Rastor Image Processor (RIP) software to convert an image created using CAD software into electronic signals the print hardware can read. The other essential elements for successful digital textile printing include a fabric feed system to register a multitude of substrate options; pre and post treatments allowing the image to fixate to the fabric and remain there after laundering in addition to inks compatible with the machine and substrate (Malik *et al.,* 2004; Ujiie, 2006).

The technology is seen as a reliable method to produce short runs of textiles commercially. The benefits include unlimited utilization of colour, tonal gradation as well as cost for short run and *strike-off* production (Tyler, 2005; Ujiie, 2006, 2011; Britt *et al.,* 2013; Britt and Shaw*.,* 2014; Nimkulrat *et al.,* 2016). Ryall and Macbeth comment in Crafting Textiles in the Digital Age:

> *"The benefit of using digital printing instead of traditional methods was the element of control that was achieved. Digital artwork was created to have many subtle gradient tones…several colours were printed at one time."*

(Nimkulrat *et al.,* 2016 pp.60)

As Curcio (2016) reports, the digital printed textile industry is worth $1.17 billion. This is expected to double by 2021. This chapter will briefly discuss the historical background and current developments in the industry, with particular focus on how practitioners are utilizing the technology to expand understanding and create innovative approaches. The next section will address the introduction of the technology to the industry and the developments that have catapulted it to its current success.

2.5.1 Historical Overview

Carden (Nimkulrat *et al.,* 2016) mentions that there are several processes and techniques involved in digital textile printing but they are not unique to this area. This is why several discoveries and inventions not specifically linked to printed textiles since the beginning of the 19th Century have led to the digital technologies available today. Tyler (2005) states the Jacquard Loom, invented by Joseph-Marie Jacquard in 1801 was the first digitised textile manufacturing process. It involved a loom, which wove complex designs utilizing a punch card. By 1878, Lord Rayleigh was describing *'the mechanism by which a liquid stream breaks into droplets'* (Malik *et al.,* 2004; Ujiie, 2006). Seventy years later, this principle would assist in the first patent for Continuous Ink-Jet (CIJ) printing (Malik *et al.,* 2004, Gudapati *et al.,* 2016). This was shortly followed by Drop-On-Demand (DOD) inkjet technology (Malik *et al.,* 2004)

Digital textile printing has been in existence for nearly fifty years, with Tyler (2005, 2011), Ujiie (2006) and Cie (2015) writing extensively on the subject. They claim the *Militron*, developed by an American company in the 1970s, was the first machine of its kind developed to digitally print onto carpets. By the 1980s, Seiren of Fukui in Japan would be developing further possibilities for ink-jet printed textiles (Ujiie, 2006). However, it would be Stork in The Netherlands that produced the first commercially viable digital textile printer (Malik *et al.,* 2004; Tyler, 2005). The *Trucolor TCP Jetprinter* could print onto a range of substrates utilizing reactive dye (Tyler, 2005). Stork was the only company to exhibit this type of equipment at ITMA 1995 (International Exhibition of Textile Machinery). By 2003, the Birmingham exhibition showcased twenty-three exhibitors with digital textile printing hardware (Tyler, 2005). As Moser notes;

'...many manufacturers believe that ITMA '03 marked the beginning of the first major commercial advance in textile digital printing since its introduction in 1991.'

(Moser, 2003, pp12)

The growth of the industry has been considerable since then. Investment in technological advancement has originated from Japan, Italy, The Netherlands and China. The 21st Century has witnessed significant digital textile printing development, appropriate for a range of applications. The progress has brought with it further stability, speed and dyestuff possibilities (Tyler, 2005, 2011; Ujiie, 2006).

2.5.2 Software

Britt (2012, 2013, 2014), Briggs-Goode (2011), Campbell (Parson and Campbell, 2004) and Doe (2012) all mention their preference for Adobe® Photoshop and Illustrator in their publications. Its popularity likely stems from the relatively low-cost off-the-shelf nature (Ujiie, 2011), which makes it accessible for a wide range of people. Other products such as CorelDraw (2018), Lectra's Kaledo Print (2018), Shima Seiki's Apex (2018) and AVA (2015) also allow the user to generate design concepts and edit, alter and simulate visualisations (Ujiie, 2011).

AVA CAD/CAM software is seldom written about in research journals and books, the researcher only found a brief mention by Ujiie (2011) and a comment in an article about Manchester University's state of the art textile centre opened in 2006 (Wilson, 2007). The majority of the literature is located on their website or website links due to a presence at Industry fairs across Europe. However, they have been providing specialist design and colour software for over 25 years (AVA, 2015) especially suited to the textile industry.

Kamat and Phadke (2014) claim that the adoption of CAD technologies has contributed to the productivity and flexibility in the design process providing the possibility of *uninhibited* thinking. However, along with Campbell (Parsons and Campbell, 2004) they clarify that the user does need the competency to operate the system to achieve the optimum results. Polanyi (1974) vocalised a theory on a lack of understanding could help outcomes from becoming flat and predictable. However, digital technology has developed significantly since. As Briggs-Goode

and Townsend (2010) note, currently it is rare to see a textile design job specification without the requirement for software skills.

The advancements in software and hardware have been integral to the industry. However, it can be argued that practitioners and innovators have extended the boundaries of what the technology can achieve. This will be discussed further below.

2.5.3 Computer Aided Design and impact on the Industry

Clarke (2011) argues that digital design as well as ink-jet printing has had the biggest impact on the printed textile industry in recent years. Authors such as Treadaway (2004a, 2004b, 2004c, 2007, 2016), Briggs-Goode (2011, Briggs-Goode and Dean, 2013), Colchester (2007) and Carden (2011, Nimkulrat *et al.,* 2016) qualify this statement. Clarke (2011) claims the creative possibilities that digital technology affords has increased the design repertoire available.

Malik *et al.* (2004) state CAD software had instigated better quality and flexibility in design development since its introduction in the 1980s. Treadaway a leading expert since the late eighties has published several papers (2004a, 2004b, 2004c, 2007, 2016) discussing the impact of digital technology utilization providing innovative approaches for the creation of textiles. This is articulated in *Creating Textiles in the Digital Age* (Nimkulrat et al., 2016, pp.21);

"Digital Ink-Jet Printing emerged in the late 1990s and stimulated wider interest in CAD by printed textile designers who were now able to render their digital images (on-screen) directly on cloth"

The introduction of CAD software has allowed the user to create and express themselves in ways not available before. Treadaway expands on the benefits of utilizing digital technology within her work:

'The design work I produced was largely geometric and comprised simple geometric pattern forms and grids that would have been laborious to draw by hand. The computer was able to speed up the process, rescale imagery, and provide a degree of accuracy that was difficult to replicate by hand'

(Nimkulrat *et al.,* 2016, pp.22)

In addition, Braddock Clarke and Harris explain:

'In order to communicate something significant about the rapidly changing age we live in, artists and designers must frequently adopt new vocabularies, visual languages and codes. Digital media now provide a myriad of different expressions'

(2012, pp.33)

The development of these new *visual languages* has led to a variety of research projects utilizing digital technologies capabilities to create innovative investigative output. Carden (Nimkulrat *et al.,* 2016) describes the investigators as *practitioner-researchers* as they use a *hands-on* methodology. At the beginning of the 21st Century, research by Parsons and Campbell (2004), Ujiie (Cooper-Hewitt, 2011) and the Centre for Advanced Textiles (CAT) (Britt and Shaw, 2014) explored digital print applications for a range of purposes. Parsons and Campbell (2004) pioneered engineered prints for apparel applications. A solution to their research witnessed engineered garments that matched flawlessly across the seams including a ball gown using stain-glassed window imagery (Fairhurst, 2008). Since this initial research, Campbell has continued to explore digitally engineered apparel (Goodman, 2015).

A vast amount of research into digital textiles has originated from Glasgow School of Art. Seen as significant innovators in the field, the investigation into the subject was instigated by the founding of The Centre for Advanced Textiles (CAT) in 2003. Operating as a commercial digital textile printing bureau service, it has established itself as a leading facility for research and knowledge exchange projects supporting learning, teaching and entrepreneurship (Britt and Shaw, 2014). It supports the digital print requirements of several designers, retailers and organisations including Bluebellgray (Figure 2.5), Jonathan Saunders, Topshop Unique and Glasgow Commonwealth Games 2014. It has also been an integral part for several research projects, including explorations by Helena Britt (2012; 2014; Britt *et al.,* 2013; Britt and Shaw 2014; Britt and Stephen-Cran; 2014; Britt *et al.,* 2014) and Andy McDonald (2010 cited in Britt, 2014). In addition, the centre has also conducted their own research resulting in exhibitions such as *Mackintosh Re-Interpreted* (Campbell, 2008) and the establishment of Classic Textiles (2018).

Figure 2.5 *Taransay* Cushion by Bluebellgray

As digital technology has progressed, certain research has migrated back to traditional applications to broaden the capabilities of the technology available. In addition, Nimkulrat *et al.* argue (2016 pp. 2) digital technology can 'lead to a more superficial approach to the origination of designs and artefacts'. This may lead to less evidence of *the hand* if digital is allowed to dominate. These two reasons have witnessed resurgence in technologically driven craft based practice. Carden in her PhD research at Glasgow School of Art 'explored the potential for hand-crafting techniques to be used as interventions in the digital printing of textiles' (Ibid. pp. 121). She draws similarities between the work of traditional craftspeople and current digital textile design. Whereas, block-printing would require an artist, engraver and printer, today we still require three entities; *one human, one virtual and one machine* to create effectively. Ryall's (Ibid.) PhD project went one-step further and encouraged designers to engage with traditional craft and design methods, applying these to digital technologies in the production of innovative textile surfaces.

Braddock Clarke *et al.* (2012) and Colchester (2007) highlight several fashion and interior designers introducing digital elements for both design and manufacture. The likes of Basso & Brooke, Mary Katrantzou, Tord Boontje, Hella Jongerius, Eley Kishimoto, Jonathan Saunders and Prada have delivered textile creations from a digital angle (Figure 2.6). From the computer-generated imagery that is screen-printed to create Jonathan Saunders signature bold fashion prints, to the entirely digitally rendered collections by Basso & Brooke, the opportunities that digital technology affords are vast and are now integrated globally within the design of textiles.

Figure 2.6 Basso & Brooke (Left), Jonathan Saunders (Middle), Mary Katrantzou (Right)

2.5.4 Benefits and Limitations of Digital Textile Printing

As already discussed, there are several design and technical benefits to digital textile printing. The manufacturer experiences several advantages versus conventional methods including shortened lead times, reduced labour costs and enhanced flexibility providing customisation at the click of a button (Tyler, 2005). Cresswell and Gilboa (2015) claim a 50% to 90% cost saving on smaller runs versus conventional printing. Campbell and Parsons (2004) highlight the beneficial nature of CAD in allowing almost instant design changes. This can lead to reduced

emotional stress when experimenting. Bowles and Isaac explain the advantages further:

'immediacy; the ability to print intricate details and millions of colours as well the possibility of printing images on a much larger scale (as well as) being able to create customised products and engineered designs.'

(2012 pp.12)

However, one of the key benefits discussed by several publications was environmental impact. The textile industry is the second largest polluter in the world (Edge-Fashion-Intelligence, 2015). Malik *et al.,* (2004) and Cresswell and Gilboa (2014) report conventional methods consume vast amounts of water and energy in addition to producing significant dye waste. Combined with manufacturers, retailers and consumers becoming more sensitive to the environmental impact of textiles (InfoTrends, 2014). Consequently, Cresswell and Gilboa (2014) report that Italian firm Miroglio Textiles reduced water consumption by <90% and CO^2 emissions by <25% utilizing digital processes. In addition, digital printing only utilizes the dye required for the print, producing no wastage.

Investment and research has witnessed a significant reduction in the limitations of the technology over the past few years. Pigment printing is now available, which for many years was fraught with complications regarding nozzle blockages and colour depth (Tyler, 2005; Mimaki Specification, 2016). Machinery developments has seen devices, which can compete with the speed of rotary screen-printing (Parrillo-Chapman, 2016a). However, Gilboa (2015) reports smaller machines are not competitive for longer runs versus conventional methods. Subsequently, *off the shelf* and *non-critical time to market* products are manufactured by conventional means (InfoTrends, 2013) as these are more cost effective. As Malik *et al.* (2004) report discharge and resist effects are unavailable. A limited colour depth (screen-print method applies five times more dye) effects its appropriateness for pile and heavy fabrics (Briggs-Goode, 2013). It is clear, digital technology has had a positive effect on research and manufacturing possibilities. The argument for conventional print textile mills to establish digital systems to remain relevant is evident. Ultimately, as digital technology has infiltrated every aspect of our society, it is important for the industry to remain current.

The next chapter will discuss the importance of revisiting our pasts in the development of new ways of working with digital technologies, focussing on how current practise is utilizing archival research in the evolution of innovative concepts.

2.6 Archive

2.6.1 What is an Archive?

The Cambridge English Dictionary (2018) describes an archive as *'a place where historical records are kept'*. Essentially, an Archive provides a storage location for the historical plethora of ephemera. These storage facilities assume several forms, including libraries and record offices (Osborne, 1999). However, Featherstone (2006) insinuates they may also reside digitally not physically, emphasising the abundance of digital archives available. These may take the form of an online catalogue of artefacts stored within a physical space, such as the Victoria and Albert Museum. Nevertheless, they might also take the form of digital files stored for prosperity, such as the records created during numerous presidential candidacies (Featherstone, 2006).

The UK National Archives (2017) houses *'collections of information'*. These take numerous forms including *'letters, reports, minutes, registers, maps, photographs and films, digital files, sound recordings'* to name a few. These archives can be created by a variety of sources. These include official government bodies, businesses or professional organisations. However, an archive may also be a private collection (NARA, 2016; Featherstone, 2000) or an individual's personal effects stored in a closet or attic (Bradley, 1999). As Britain's National Archives (2017) state, these collections can be well-documented storage facilities but can equally be unorganised collections of treasured memories.

2.6.2 Why do we have archives?

Featherstone (2000) citing Derrida (1996) highlights the Greek origin of the word Archive. The term *aekheion* references the residence of the superior magistrates who were the individuals in command. It was the place where official documents were filed. The *archons* had the right to *'interpret the archives and speak the law'* (pp.167). The Greeks were *filing* the information assuming a cataloguing system.

Essentially, they were bestowing reason onto the collated items. This is similar to the role of the archivist or historian today.

By the 18th Century, European archives began to appear. These archives were initially linked to *sovereign power* and *royal memory* (Osborne, 1999; Featherstone, 2006) highlighting the importance of the monarchy during this period. Originally, the collation of information was generally one of power rather than preservation (Featherstone, 2000). However, as archives became public beginning with The French National Archive in 1794 (Osborne, 1999), it began its transformation into the repository of the *national memory* (Featherstone, 2006). Lengwiler (2013) and Chrisman-Campbell (2013) highlight a Western fascination with historical documentation and artefacts displaying a symbiotic relationship between the development of society and archival growth. This can be witnessed through the many archival exhibitions during the 19th century. These included *The International Exhibition* held in London in 1862 and *The Philadelphia Fair* in 1876.

2.6.3 Why are archives important to research?

Featherstone (2006) claims, the plausibility of research is dependent on the sources utilized. This is a key reason why it is essential that we have these resources to store the vital information required. As Osborne (1999) highlights, the archive presents

> *'…a useful focal point bringing together issues of representation, interpretation and reason with questions of identity, evidence and authenticity'.* (pp.51)

Ultimately, Bradley (1999) argues information is a culturally valuable commodity and the archive provides the facility to manage our past.

Traditionally, the archive has been the home of the history scholar. Ernst (1999) defines the archive as providing the opportunity to *tell history as it was.* It awaits the *gaze* of the historian to carefully scrutinise the material to bring the artefacts to life (Featherstone, 2006). However, in the current climate, the potential for other users to access archives has materialised. As Bradley (1999) states, the archive now offers *promises and seductions* for many types of researcher, from the historical to the creative.

Truth is the epitome of a history scholar's research. However, the truth presented can be manipulated. Throughout history, this has been mainly due to political gain (Osborne, 1999). Conversely, for the creative, truth is a less defined construct to research avenues. Creative research focus, whilst still attentive to historical accuracy, may also be concerned with personal interpretation. A desire to preserve history through alternative methods may lead to success. Whereas a history scholar often does not succeed due to the immense *overload of objective culture* (Featherstone, 2000) an archive offers. It is apparent that archives offer the researcher opportunities not otherwise available. This has led to several creative researchers and designers utilizing archival research within their investigations and practice. This will be explored further in the next section.

2.6.4 Designers, Artists and Brands utilizing archives within practice

There is currently a myriad of creatives utilizing archival resources within their research output. For the purpose of the research, the focus will be on practitioners combining archival research with a primarily textile output.

Colchester mentions Timorous Beasties initiating a following in the textile world in the nineties with the introduction of;

'...printed textiles that synthesize both the historical and the countercultural tendencies'

(2007, pp.113)

They created prints of *beasties* derived from 19th Century scientific drawings of insects. Their fascination with the archive led to the socially and politically charged *Glasgow Toile* in 2001 inspired by *toile de jouy* of the 1770s (Figure 2.7). In 2009, they collaborated with the Ruskin Collection in Sheffield on an exhibition called *A Bird in the Hand* (Design-Week, 2009). Focusing on the bird and insect illustrations contained within the archive, they created a range of digitally printed lamps and furniture with delicate interpretations of the drawings held within. According to Design Week (2009) they created;

'...a surreally beautiful interpretation of Victoriana, with an element of modern cheekiness'.

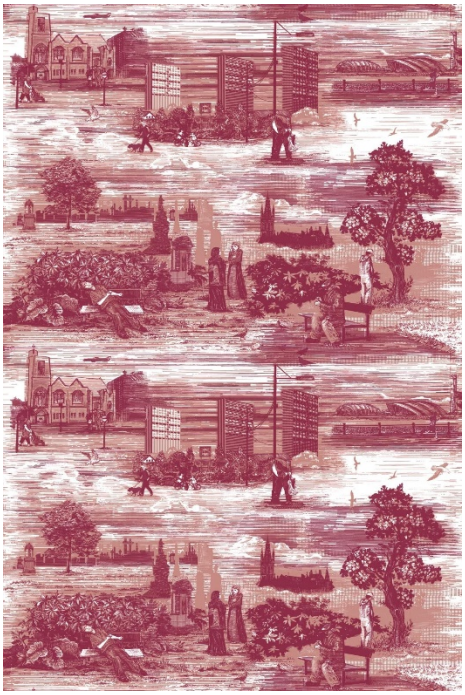

Figure 2.7 Glasgow Toile by Timorous Beasties

Patternbank (2015) mentions Oasis' (fashion brand) collaboration with the V&A. They utilized archival inspired botanical prints and feminine florals on kimonos and dresses from the world famous archive.

The lure of the archive has also encouraged brands, such as Marks and Spencer, Pringle and John Lewis, to exploit their own back-catalogues and archived resource in recent years. As Cattell (2016) comments;

'...there are many rewards to be reaped from brands digitising their heritage collections'.

The main reward from a commercial perspective is the generation of revenue from already created merchandise.

However, Pringle of Scotland collaborated with London's Central Saint Martins College of Art and Design in 2012. Students produced knitwear inspired by argyle patterns and *trompe l'oeil* prints motivated by the company's archives and first-hand conversations with employees from the fifties and sixties (Battista, 2011). The garments were showcased at Florence's *Pitti Filatti Trade Show* and at Glasgow's iconic *Barrowland* music venue. John Lewis digitised some 2000 textile designs,

which are now accessible to relevant departments across the company. The images are predominantly utilized by the design team to inspire new products and designs (Cattell, 2016). An example of this is an archived textile pattern repurposed on a new range of crockery for Waitrose stores. However, Marks and Spencer has witnessed extensive utilization of their back-catalogue. Establishing an online resource called *Marks in Time* through to a permanent exhibition highlighting documents, photos and film from 130 years of trading (Marks & Spencer, 2018). This has proven how lucrative the past can be. Recently, it has culminated in collaboration with British style icon, Alexa Chung, creating a 31-piece womenswear collection inspired by their archive (Klerk, 2016).

However, the work of these high profile brands only touches the surface of the extensive research undertaken on the subject. Glasgow School of Art (GSA) are pioneers of research into archive utilization. Investigations initiated by the institution have led to the preponderance of publications on the subject. However, other relevant research projects should not be neglected. Explorations originating from Nottingham Trent University and collaborations between Ulster University and Manchester Metropolitan University have provided the research community with key data to understand and further utilize these resources.

Glasgow School of Art are one of the leaders in research utilizing archives for creative output. The project, *Awaken*, led by Jimmy Stephen-Cran (Britt *et al.* 2013) was initiated by the lack of literature written about designers utilizing archives within their practice. It investigated the creative possibilities provided by reinterpreting archival material. Fourteen practitioners were tasked with utilizing archival artefacts in the creation of fresh, primarily textile based output. The aim of the research was to understand how different practitioners utilized archival artefacts to enhance their understanding of the textile design process. They were encouraged to critically reflect their process through a journal and make several visits to the Archives and Collections Centre (ACC) at GSA. The imagery collated was translated using several different processes, including traditional and current print methods. Concerns stemmed from producing unoriginal artwork to how close the resulting work had to link to the selected material. Ultimately, it provided further

opportunities to exploit the potential of archives within creative fields especially in a commercial context.

Kate Scardifield is an Australian mixed-media artist whose output has an archive based starting point. Similar to the *Awaken* project, Scardifield's current creative work has resulted in a touring exhibition called *Ley Lines* (2018). The textiles, sculpture and installations on display are a response to visiting archives and collections around Scotland. She has crafted links with her own heritage working with Brisbane's collected astronomical equipment. The artefacts on display fluctuate dependent on where the collection is displayed, highlighting the different *stories* dependent on location (Panel Glasgow, 2018)

Stephen-Cran and Scardifield highlight one approach to archival research, utilizing the resource to originate new work capturing the stories of the past in innovative ways. However, research into the subject has also concentrated on highlighting and reigniting significant historical methods and achievements.

Britt (2014) and Chappell (2014) examined the history of Scottish carpet design focussing on the archives of James Templeton & Company and A F Stoddard & Company. Stoddard Templeton utilized a design library; essentially an archive of materials, which influenced the carpet, designs. The collaboration resulted in an exhibition presenting items from the archives. As well as outreach activities and widening participation workshops encouraging further learning, teaching and research related to archive utilization. The research of Briggs-Goode (2013) into Nottingham Lace was instigated by a resurgence of lace in contemporary culture and art and design practice. However, it also highlighted the importance of lace to Nottingham's identity. City wide participatory events provided by *Lace: Here: Now* (Nottingham Trent University, 2012b; Briggs-Goode and Dean, 2013) and other access widening programmes organised by the University highlighted the importance of archival research in boosting educational and city appeal. As well as encouraging the public to access and celebrate their heritage. Similarly, projects such as *Classic Textiles* (2018) and *Mackintosh Re-Invented* (Campbell, 2008) from CAT at GSA have originated from a surge in historical interest. Recreation and reinterpretation of archival textiles has led to commercial opportunity and a widening appreciation for our histories.

Finally, archives can provide the opportunity to recommission or update techniques. Belford (2014) redeveloped *Shadow Tissue* from the 1920s adapting it utilizing 21st Century techniques. *Shadow Tissue* is a process pioneered by Turnbull & Stockdale, a Lancashire textile company. It involves a fabric developed from printed warp yarns, followed by weaving with variable weft yarns. The process of weaving shifts the printed pattern, creating a shadow effect. Belford worked collaboratively with Dr. Sykas, Research Associate at Manchester Metropolitan University as well as a print designer, historian and archive manager. Belford anticipated that by uncovering past knowledge in an *archaeological* manner, she would develop innovative ways of examining a '*complicated hybrid technique'* (Belford, 2014, pp.116). The collaborative approach allowed for the circumnavigation of knowledge and skill barriers, such as registering screens or unstable warps. As well as receiving the in depth knowledge held within the archives themselves. Belford's scientific approach, termed *experimental archaeology* aimed to create a deeper understanding of the archived methods instead of direct copying of the technique. Historical findings fed into the practical stages, supporting further investigation and practical outcomes. The final result was an;

'...innovative and successful warp-printed designs that are neither a print nor a weave, but can stand along as a new mysterious shadow tissue'

(Ibid. pp.131)

The different approaches discussed above, identify potential of archives in inspiring creative output. Britt (2014) mentions that there is a limited amount of literature regarding archive utilization in design. However, the emphasised investigations stress several approaches to utilizing the potential of archival material. It is apparent that archives store a plethora of information which can be utilized in many different ways which provide the researcher several opportunities. These include educational, artistic, innovative and commercial prospects cementing textiles past into our future endeavours.

The final section will discuss the importance of copyright when utilizing archives in the creation of design work.

2.7 Copyright Law

Padfield (2007, 2012) claims copyright law is important and in principle simple. It allows the copyright owner to protect and control how they want their work to be utilized in the public domain. The owner can be the originator however can also be the employer or commissioner of the work. The right is granted by parliament and has witnessed several amendments and alterations throughout the years. However, in all cases, it only applies for a limited time. In practise, it can be complicated. As Peters (2011) mentions;

> *'...copyrighted information has never before been so freely available however subsequently brings with it the challenge of understanding what is and is not allowed when it comes to copyright law'.* (pp.592)

The shift from print to digital has changed the way information is created, accessed and utilized. Copyrighted information is freely available and subsequently open to *reconstitution* by the user. However, it is paramount in scholarly research enabling learning and scholarship. Ultimately, it discourages plagiarism whilst encouraging thinking and originality in research (Peters, 2011).

2.7.1 Copyright implications for textile design

Padfield (2012) discussed two distinct groups for artistic works. There are the works, which require no particular artistic quality, it does not need to be good art or even have originated as art at all. The other group is intended to appeal to the eye, not dependent on the viewer's predilection. The first group includes paintings, drawings, maps, forms and diagrams. Whereas the second group focus is on artistic craftsmanship and includes bookbinding, stained glass and pottery. Textile design originally seen as an Industrial art form is now classed as an artistic work (Padfield, 2007).

The standard term for copyright is until the end of the year in which the author died then a further seventy years. For unknown authors who cannot be identified by enquiry, it is seventy years from creation or publication (if within 70 years of creation). Unpublished and anonymous works may incur copyright as late as 2039 due to legislation. If the copyright owner is not the originator, then it is still dependent on the artists' life (Baumgart, 2012; Padfield, 2012). This means design firms need to be aware of staff death for copyright reasons (Padfield 2007, 2012).

2.7.2 Copyright issues for utilizing archival material for educational and commercial purpose

Padfield (2012) mentions that several uses of artistic works are called *restricted acts.* This means only the copyright owner can provide permission to utilize without infringement. For instance, in the case of *Classic Textiles* at GSA, they have sought permission from the designer or designers' family to reproduce their fabrics commercially. Restricted acts include;

- Copying
- Publication (for instance the issue of hard copy in publications such as a book or exhibition catalogue)
- Communication to the public (including online communication)

However, artistic works may be exhibited in public without infringement and within catalogues, which advertises them for sale. Librarians and archivists are not exempt from the exceptions. They must seek permission to create copies for preservation purposes including if they decide to digitise their collection for online access. Several organisations worldwide have and are currently digitising their collections such as the V&A, which will have been affected by copyright law.

The use of copyright works by educational establishments for non-commercial educational purpose is covered by a range of exceptions. These exceptions apply to teachers, students and in some cases other staff at the establishment, but do not apply to parents. Subsequently this entitles a student to utilize copyrighted material for an examination, such as a dissertation or thesis (Padfield, 2007).

CHAPTER THREE – RESEARCH METHODOLOGY

3.1 Introduction

This chapter will discuss the research methods utilized to challenge and support the aims of the investigation. Consideration for the methods adopted to inform the research will be realised through explanation of the rationale and execution of the project.

The methodology has resulted in several approaches being adopted. Initially, development of the required skillsets was necessary to establish an investigative route. However, the skill development is ongoing and will continue after the research project is complete. The methodology also encompasses the development of analysis tools through archival case studies and subjective examination and evaluation of created samples. Ultimately, the utilization of qualitative consideration from other sources will help establish if the research has captured the fabric qualities outlined.

3.2 Developing the skillsets

Ryall (Nimkulrat *et al.,* 2016) in her PhD research project assumed the role of *craftsperson, designer and technician*. This approach revealed that creatively collaborating in this way provided the potential for the researcher to develop innovatively with *confidence, creativity and experimentation*. The author assumed this methodology, noting the benefits of time efficiency and skill development. By negating the reliance on other people's skillsets to accomplish the majority of the investigations would provide a time efficiency advantage. Learning the required digital skills would provide essential skill development. However, to assume this role, the researcher required the opportunity for training to further develop the skillsets and knowledge already acquired personally and professionally.

3.3 Using the Digital Printers

Independent operation of the digital printing machines available was an appropriate place to begin. Instruction was provided by the Digital Print Technician commencing in November 2014. At this point, the University had two printers in operation;

Mimaki Textile Jet TX-1600 S (Printer 1)

Mimaki Textile Jet Tx2-1600 (Printer 2)

Printer 1 was replaced in September 2017, with a new device;

Mimaki Tx300P-1800 (Printer 3)

Printer 1 was limited to thinner substrates due to an un-adjustable head height. It had a maximum printing speed of 4.6m²/hour with the option for Reactive or Acid dye ink (Mimaki, 1996).

Printer 2 has an adjustable head height function allowing substrates up to 7mm thick, a maximum printing speed of 28.4m²/hour with the option for Reactive or Acid dye ink (Mimaki, 2003).

Printer 3 has the capability to print directly onto almost any man-made or natural fabric with the option for five ink types (Sublimation, Disperse, Pigment, Reactive and Acid). However, ink type cannot be changed after installation so the most appropriate dyestuff for application is selected at installation stage. It delivers a maximum speed of 68m²/hour with adjustable head height up to 1cm thick (Mimaki, 2016).

Printer 1 and 2 use the RIP software *StudioMaster* (Figure 3.1) allowing the user to set media size with options to set repeat and scale to achieve economical use of the fabric width (Figure 3.1). Printable files are to be provided in RGB colour mode in either a PSD (Adobe® Photoshop) or TIF(F) file format (Ujiie 2006).

Printer 3 is supplied with RIP software to maximize performance of the machine (Mimaki, 2016). TxLink3 Lite RIP software provides multi-colour separation allowing printing utilizing spot colours delivering a wider colour gamut and higher colour reproducibility compared to previous options (mimaki.com/product/software/rip/txlink3/). Other functions include colour replacement, step and repeated pattern creation supporting RGB colour model and raster images.

Knowledge of the operation of the digital printers provided independent development of samples. The Digital Print Technician continued to provide support

when necessary throughout sample development. However, by negating sole reliance on the technician to print out the samples provided the investigation flexibility to print whenever a new idea surfaced.

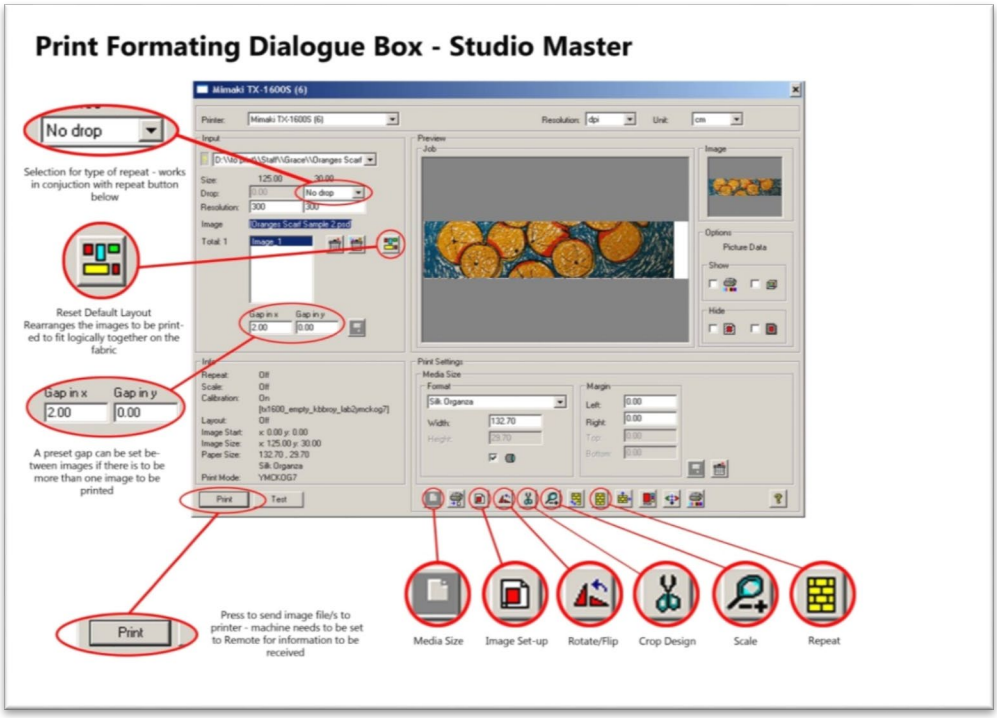

Figure 3.1 StudioMaster Dialogue Box (DP Innovations & Grace Smith, 2015)

3.4 Knot Knit

The first opportunity to utilize the digital printers was presented by a collaborative project proposed by staff members, Mark Parker and Fiona Jardine at the School of Textiles and Design in January 2015. The resulting investigation by the author called *Knot Knit* (working title *Knit-Print-Weave*) formed the beginning of the research discussed in this thesis.

Collaborating with Borders Textile Towerhouse and The Heritage Hub situated in Hawick, in the Scottish Borders, a selection of staff created personal responses to the knit textile archives. The process culminated in a presentation of work in the exhibition *Swatches, Samples and Sketchbooks* (2015) at the Textile Towerhouse, September to November 2015.

The project, *Knot Knit,* intended to investigate three themes;

1. Utilisation of AVA (www.avacadcam.com) design software to create repeating design layouts and separations for screen and digital textile printing.
2. Using modern (digital) and traditional (screen) textile printing methods to transfer the design concepts generated (point 1.) onto fabric
3. Varying the substrate choice for both printing methods (point 2.) to experiment with feel, drape and visual appearance

By employing these three concepts, the intention was to achieve realistic visual and tactile characteristics displayed within the original source material through a series of sample swatches (Appendix A, pp.155-161). The decision for this route of investigation was to develop the necessary skills on the AVA software and digital printers, providing scope for future research. However, the opportunity to utilize archival resource would also prove advantageous to the development of this Master's thesis. The Archive and related resources as a research tool will be discussed in the next section.

Further discussions of the outcome of the *Knot Knit* project can be found in chapter 4.1.

3.5 Archive

Existing literature was reviewed to contextualise the role of the archive in developing innovative textile design outcomes. In addition to this, the physical archive in relation to this project had several avenues of investigation. Initially accessed to provide a creative starting point, similar to the *Awaken* research project at GSA (Britt *et al.,* 2013). It would become a place of reference that would inform the characteristic case studies (Chapter 4.3), comparable to the research into Shadow Tissues by Belford (2014) at the University of Ulster.

The terminology *archive* evolved during the investigation. Originally thought as a storage facility of the ephemera of history, as described in the Cambridge English Dictionary (2018), the word transformed as the research was conducted. As Bradley (1999, pp.108) comments *'potentially anything is significant for archival reason…various personal collections in biscuit-tins, show-boxes and old suitcases in the attic'*. This led to a variety of archival sources being considered within the methodology outlined.

3.6 Accessing relevant visual and literature information

To begin with a series of online and literature searches were conducted. By accessing online archives, such as the V&A and GSA and relevant books allowed the author to gather relevant images and paraphernalia associated with the defined era. This provided a wealth of relevant designers and designs (Appendix C pp.176-178; D pp. 179-186) to utilize for further investigation. However, due to the requirement of *physical* characteristics to be examined, it was necessary to investigate the availability of tangible artefacts through first-hand contact.

3.7 School of Textiles and Design Archive, Galashiels

Initial physical investigations were conducted at the archive held at the School of Textiles & Design in Galashiels. The Archivist was supplied with a list of relevant designers from the 1930s to 1950s era. Before this point, the author had selected to focus on the 1950s era. However, upon investigating the artefacts held within the initial and most easily accessible archive, it was decided to broaden this timespan to correspond to the artefacts available. The Archivist selected fabric samples from the defined era as per the document provided (Appendix B, pp.163-175). However, the archive was limited to specific manufacturers and designers due to its location and the collections it houses. The fabric samples available provided a snapshot of the design style and process available during this era (Appendix B, pp.163-175).

3.8 Purchases

To supplement the initial archival investigations coupled with the realisation that handling of the artefacts posed its own issues surrounding preservation; the author proceeded to purchase fabrics online. Due to the era being within living memory with significance and interest to certain demographics rendered this process easier. Several fabrics were purchased with origins known and unknown (Appendix C, pp.176-178). This would allow the author to handle and manipulate the fabrics if and when necessary.

3.9 Visiting Exhibitions and Lectures

Finally, to gather further information on the designs and designers of the era, relevant exhibitions were attended. During the investigative timeframe, the author had the opportunity to attend *Pioneers of Post War Pattern* (2017) at Glasgow

School of Art. As well as this, the travelling exhibition of *Picasso to Warhol: Artist Led Textiles* (2018) exhibited at New Lanark Mill and had an accompanying lecture (Picasso to Warhol: Artist Led Talk, 2018) at the Dovecote in Edinburgh. The *Pioneers of Post War Pattern* (2017) not only provided access to original textiles from the era but also indicated how GSA's digital print department had developed them into a current commercial venture. This will be explored further in Chapter 4.2. *Artist Led Textiles* (2018) provided additional source imagery and further historical clarification relevant for the literature review.

3.10 Analysis of source fabrics

To establish if it is possible to achieve the research question outlined, case studies of three fabrics were undertaken. The fabric swatches were selected from purchased and archival sources. Utilizing the author's previous knowledge and experience, the fabrics swatches were analysed to characterize and provide explanation as to the features that defined the fabrics from that era (Chapter 4.3). It was at this point that the decision was made to solely focus on the characteristics of the print. Colour and Motif were originally deemed too wide an investigative remit. However on closer inspection, the researcher realised these features were of importance in a general sense and were ultimately included at the testing stage.

3.11 Formation and Collation of Analysis Criteria

The characteristics outlined during the case studies were categorised and verbalised (Chapter 4.3) into a criteria matrix. These would form the analysis criteria utilized in the examination of future digital sampling. To simplify the analysis of the fabric samples created, the author created a *Criteria Flowchart* (Figure 3.2). This allowed the author to analyse the fabric samples produced efficiently after each test.

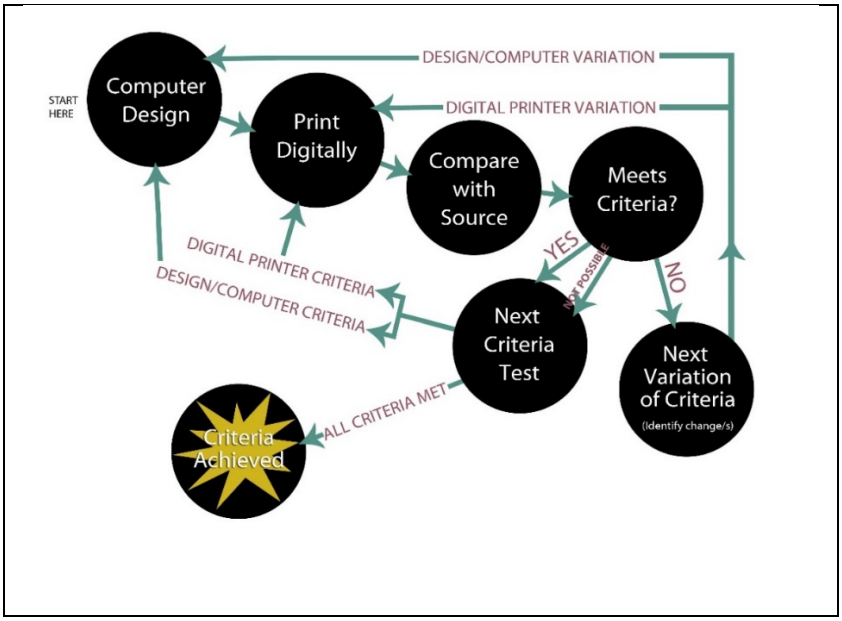

Figure 3.2 Criteria Flowchart

3.12 Creating the samples utilizing AVA software

To have a series of samples to print digitally, the original source had to be recreated utilizing the AVA software. Certain criteria to capture could be rendered using the software package whereas other criteria would be implemented using the digital printers (see below). Within each test batch, one or a series of criteria were explored and applied. Once the author was satisfied that the digitally created image successfully captured one or more of the criteria then a 25cm^2 portion of the image was saved as a TIFF file to print on the digital printer.

3.13 Production and Recording of samples

Samples were produced digitally and manually. Digital printers TX2 and TX3 and screen-print facilities were utilized. The majority of samples were digitally printed. One set of samples was screen-printed for comparison purposes. There were 22 tests totalling 100 fabric samples (Appendix E, pp.187-212). These tests explored the different criteria through digital manipulation on the AVA software program (Appendix E, pp.187-212) and altering operational parameters of the digital printers. After the printing of each set of samples, they were finished as per the reactive dye instructions (Steamed at 101°C for 10 minutes, Prewash then 60°C wash cycle). Swatches of the samples were recorded in a journal (Figure 3.3, 3.4) with relevant notetaking for each experiment. One swatch was recorded after steaming before

washing. The second swatch recorded after steaming and washing. The remaining sample was cut to the size 18 x 22 centimetres, rolled edged and labelled appropriately. This is the sample, which would analysed against the criteria flowchart and original source images and fabrics where appropriate. The face and reverse of each sample was scanned into the computer and recorded on an information sheet providing the author with the relevant information required for further experimentation (Appendix E, pp.187-212). The information recorded included Test Name, Criteria undertaken, Design utilized, Print Method with technical information, Substrate choice, Finishing and Notes of interest from the experiment.

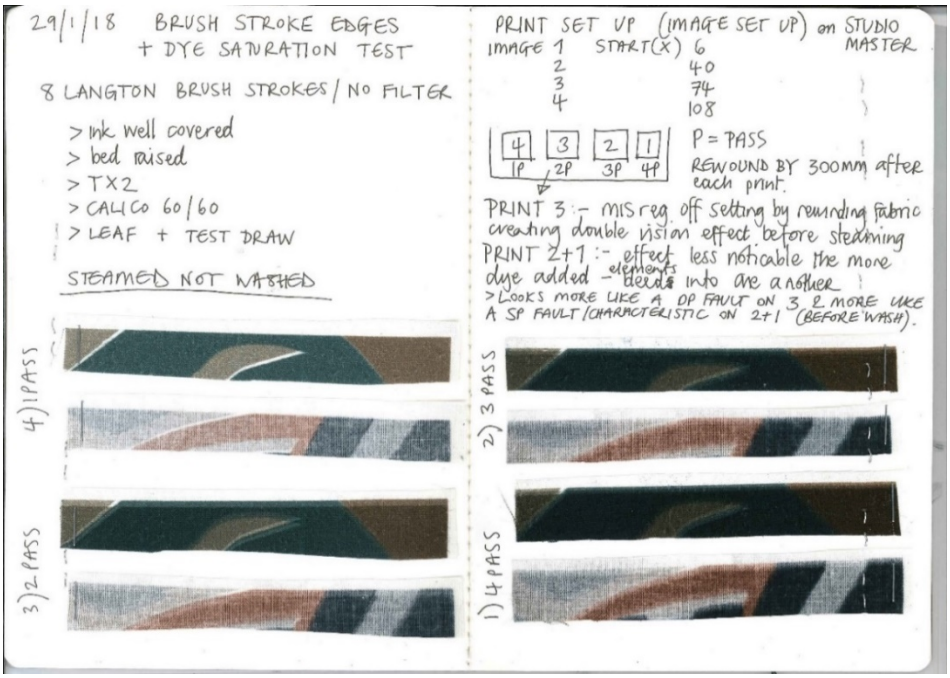

Figure 3.3 Test Notes – Steamed not Washed

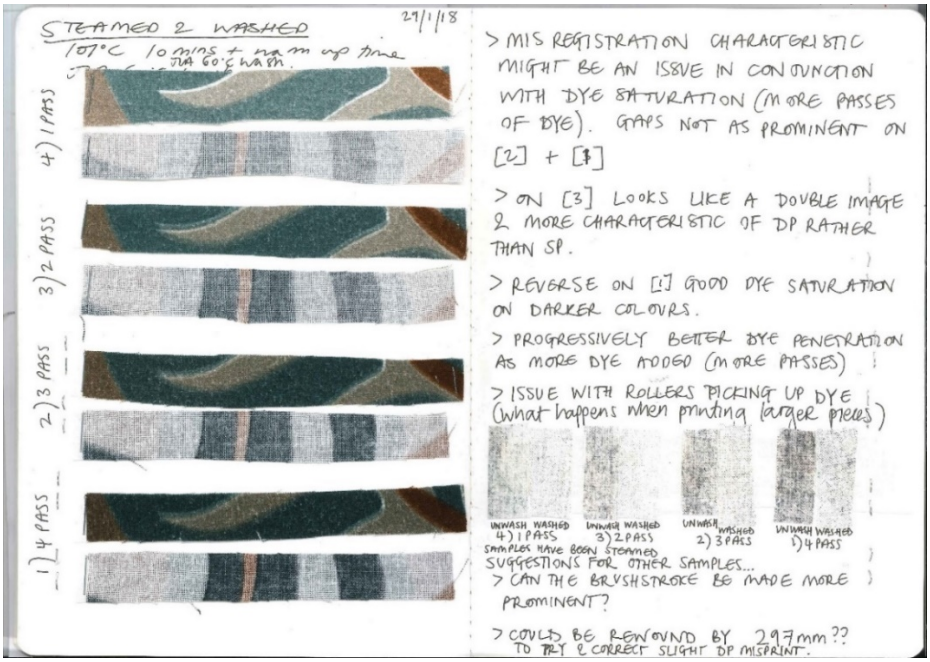

Figure 3.4 Test Notes – Steamed and Washed

3.14 Variables

There were severable variables to consider. The choice between two digital printers and substrate choice provided the author with multiple considerations. The older TX2 printer provided the author to manipulate the machine whereas the newer TX3 provided functions within the settings that could be programmed to simulate the manual manipulation required of the former machine. The author found at times that digital development provided solutions to the aim without having to manipulate the methods on offer. However without gaining an understanding of the methods on offer, this understanding would never have been reached.

Substrate variations were kept to a minimum to allow the digital characteristic criteria to be at the analysis forefront. Alternative substrates were utilized when necessary to test a criteria or for general analysis opportunity.

The fabrics selected for testing were;

- Calico 60/60
- Cotton Poplin
- Wexford Linen
- Shantung Silk

3.15 Visual Analysis of samples

The samples were analysed against the defined criteria with reference to original source fabrics. Sample production would continue throughout the research. Due to the subjective nature of analysis, there were continuous dialogue of new samples to test. Allowing the author to analyse the samples was decided because of prior knowledge and experience of the required characteristics. When one batch of samples was complete, the author would analyse the result and figure out the next step. This might be to develop the criteria further or to move onto other criteria dependent on the result.

3.16 Establishing if the criteria had been achieved

Initially, the developed criteria were applied to a digitally created design. Following application, a questionnaire was developed. The questionnaire solicited responses in reference to two samples. One developed from an archival source (Figure 4.73) and one developed from a current digital design (Figure 4.74). This was to gather further understanding as to the characteristics respondents found crucial to an archival fabric source and if the developed criteria had been captured. The interview comprised fifteen questions. Questions one through four covered personal information. Questions five to fifteen related to the samples provided (Figure 4.75). To permit a wider demographic of participants, the researcher devised grouping of words denoting *archival* and *modern* to aid perception of their meaning in relation to the research. *Archival, vintage, old* were used to describe *archival. Contemporary, modern, current* were used to describe *modern.*

3.17 Further understanding of the Industry

Finally, an interview with Industry professionals was undertaken to establish further comprehension of the effect of digital printing on the textile print industry. In addition, this provided more information on archive utilization and historical application of print methods.

CHAPTER FOUR – FINDINGS

4.1 Knot Knit

As discussed in the Research Methodology (Chapter 3.4) the *Knot Knit* project formed the initial investigation. The primary intention was to establish the potential of digital technology in the preservation and advancement of traditional fabric making techniques.

Three areas for investigation were identified;

4. Utilisation of AVA (www.avacadcam.com) design software to create repeating design layouts and separations for screen and digital textile printing.
5. Using modern (digital) and traditional (screen) textile printing methods to transfer the design concepts generated (point 1.) onto fabric
6. Varying the substrate choice for both printing methods (point 2.) to experiment with feel, drape and visual appearance

Inspiration for the project was gathered from a range of knit based companies and resources from the Hawick Archives. These included Peter Scott (PESCO), Robert Pringle & Sons, Braemar and Ellaness (now known as Hawick Knitwear Ltd).

It engaged inspiration from a pair of Second World War issue *Utility* Long Johns (Figure 4.1), believed to be knitted by Robert Pringle & Sons for submariners. These were not the most visually exciting of garments however were chosen for two reasons. The first was because they formed a key part of history and a simple story that resonated. They showed the importance of how effective a simple garment could be in providing warmth and comfort during the war effort by an industry integral to British life. Secondly, the simple ribbed structure provided a challenge when using the proposed digital tools.

Figure 4.1 Second World War Utility Long Johns (Hawick Archive, 2015)

Varieties of knit structures were examined in the sample books and garments available to view in the archive (Figure 4.2). Once the long johns had been selected, it was necessary to develop the knit structure into a repeat pattern. AVA was utilized. The focus on a simpler knitted structure provided the time to develop the necessary software skills required.

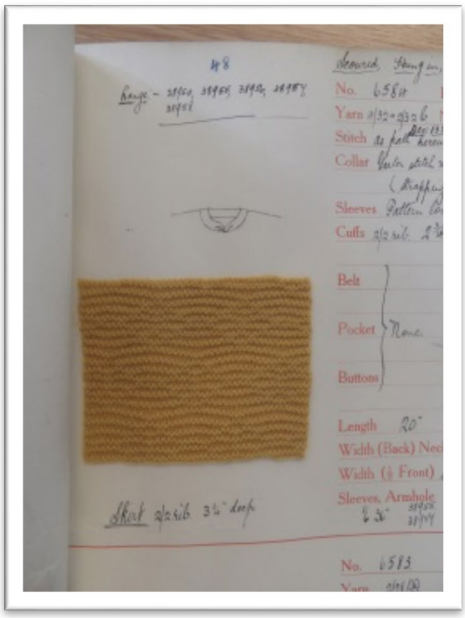

Figure 4.2 Peter Scott & Company (PESCO) Swatch Sample Book (Hawick Archive, 2015)

Issues such as shadowing (Figure 4.3) on the source photographs and retaining the fabric quality (knitted fibrous wool fibre) were primary concerns. Utilizing the

cloning tool achieved this. Firstly, by smoothing out prominent join lines (Figure 4.4). Secondly by retaining the fibrous nature of the source (Figure 4.5).

Figure 4.3 Highlighted shadowing on original fabric repeat (Grace Smith, 2016

Figure 4.4 Noticeable Repeat on Knot Knit Design

Figure 4.5 Final Knitted Structure in Repeat (Grace Smith, 2016)

The repeating design was created into three interpretations (Figure 4.6) which were used for the final samples;

- Design 1 (*Natural Original*) uses the original colours from the archived photograph
- Design 2 (*Grey Original*) is in grey scale
- Design 3 (*Grey Screen*) is separated into six colours from the grey scale image using the *Automatic Separation* tool in AVA. In addition, it was digitally printed.

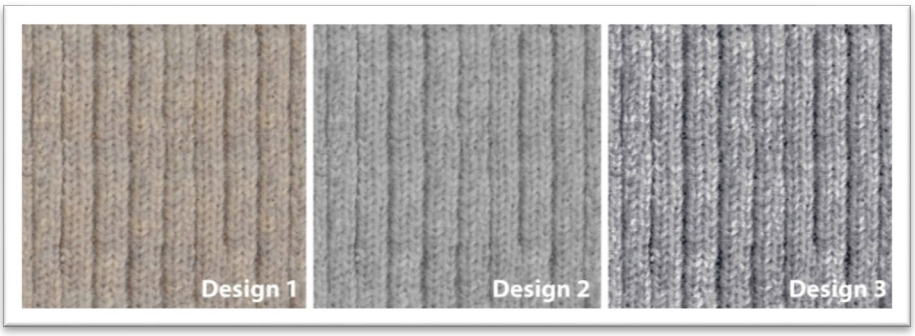

Figure 4.6 Three interpretations of the knitted structure in repeat (Grace Smith 2015)

Fabrics were chosen primarily for their physical characteristics and not their compatibility with the digital printers. Characteristics included slubs in the yarn, unusual surface decoration, mixes of fibre content and woven structure.

Four fabrics were selected from fabric supplier Whaleys (Bradford) Ltd;

- Voile Cotton WBL49 White
- Herringbone Silk Lazuli Bleached
- Cascade Silk Bleached
- Crandon Linen/Cotton/Wool Natural

Cotton Poplin was chosen as a comparison substrate for its flat smooth appearance and plain weave structure.

Selected fabrics needed coating with the correct chemicals before the application of the dye (Appendix J, pp.268). The pre-coated fabrics were dried naturally and ironed onto a backing paper (Figure 4.7) (Whaleys (Bradford) Ltd Heat seal paper), to allow easier registration and insertion into the digital printer (Mimaki, 2006).

Both the Tx1 and Tx2 digital printers were utilized (see Chapter 3.3). Tx1 was used for the thinner substrates (Herringbone, Voile) as the head height cannot be adjusted. Tx2 was used for the thicker and fibrous fabrics (Cascade, Crandon). Cotton Poplin was printed on both machines for comparison purposes.

Figure 4.7 Fabric sample on backing paper with corresponding measurements (Grace Smith, 2015)

After printing (Figure 4.8), the fabrics are steamed for ten minutes at 101°C to activate the pre-coating and combine the dye to fibre. The samples were washed, in this case in the Electrolux Wascator with Program 15 BS EN 26330 6A 40°C to remove unfixed excess dye.

Figure 4.8 Printing Knot Knit Samples on Printer 1

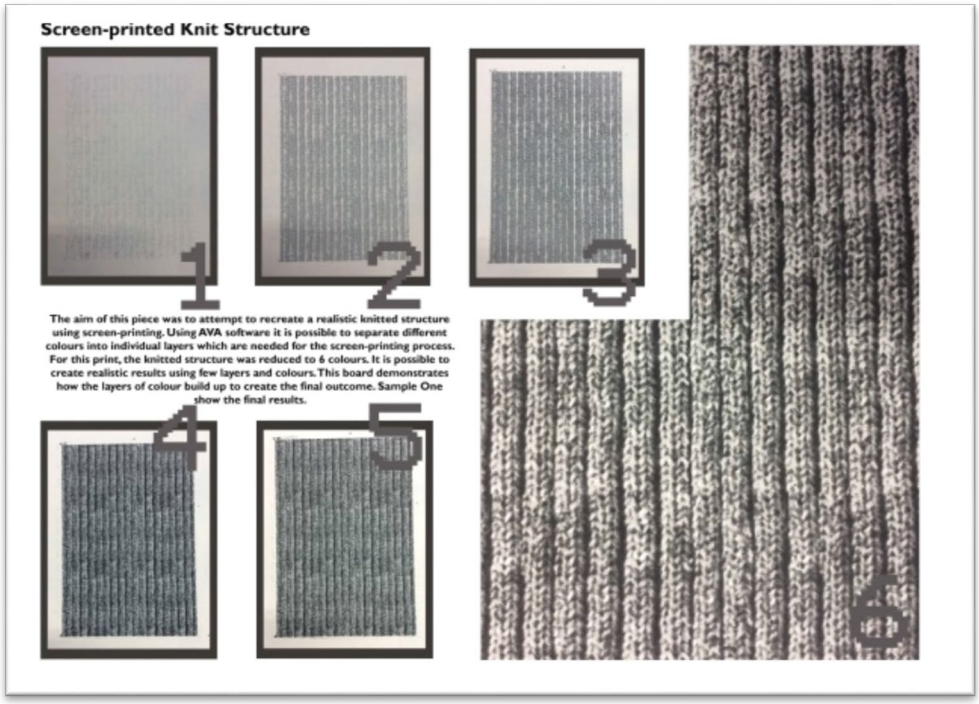

Figure 4.9 Screen-printing step-by-step information board created for Swatches, Samples & Sketchbooks Exhibition (Grace Smith 2015)

For the screen-printed samples, six separations (Figure 4.9) were created using AVA, printed onto acetate with registrations marks added to aid screen matching. Screens were prepared. Pigment colour was selected as the researcher found it simpler to colour match and alter if necessary. A pearl binder was utilized for one of the separations with the intention of creating a highlight mimicking three dimensionality of a *knitted* outcome.

Only two fabrics were printed due to it being a time-consuming process. Each screen was registered individually and printed with four passes of the squeegee. To provide fixation, they were baked (dry heat) for 120 seconds at 150°C in a heat press.

Nineteen samples were printed (Appendix A, pp.156-162) and a selection of them presented as part of the *Swatches, Samples & Sketchbooks Exhibition* (2015) at the Textile Towerhouse at the end of 2015 (Figure 4.10). Samples were presented rolled at the top, to allow the viewer to witness the difference between the original fabric on the reverse and digital/screen print achieved on the face.

Figure 4.10 Swatches, Samples & Sketchbooks Exhibition, Textile Towerhouse, Sept – Nov 2015L-R Picture of final display/Picture of final display 2/Close up of fabric swatches (Grace Smith 2015)

4.2 Exploration of an exhibition - Pioneers of Post War Pattern

Whilst reviewing the relevant literature, the researcher identified Classic Textiles as a pertinent commercial venture applicable to the investigation. It was established by the Centre of Advanced Textiles (GSA) in 2003 (Cat Digital, 2014). As it states on their website, it has been *'established to accurately recreate textile design classics of the 20th Century using state of the art digital printing technology'.*

In September 2017, Glasgow School of Art held an exhibition, *Pioneers of Post War Pattern* (2017) which was triggered by Lucienne Day's centenary. It featured archival fabrics, paraphernalia and reproduced digital fabrics developed by Classic Textiles. The exhibition featured original designs by Lucienne Day and Glasgow School of Art (GSA) alumnae; Sylvia Chalmers, Dorothy Smith and Margaret Stewart as well as digital fabrics and products by Classic Textiles.

The researcher identified several topics explored further below;

4.2.1 Scale

The size of the original designs had been altered dependent on the product. There were a selection of final products available, including tea towels, cushions and wall hangings/canvasses. Designs were scaled up for products such as wall pieces and scaled down for cushions and tea towels to allow more of the design to be visible within the product (Figure 4.11). Fabric by Lucienne Day and Sylvia Chalmers (as well as Robert Stewart and Lana Mackinnon from the website) was sold by the metre. This tended to mimic the scale of the original, observed by the Lucienne Day fabric on display. The work of Dorothy Smith and Margaret Stewart had been reproduced specifically for the exhibition. The researcher assumed this was because they were alumnae of GSA and their sketchbooks and fabrics were accessible within the University's archive. Scale could be explored in more depth due to the utilization of computer software and digital printing in comparison to the available options when the designs were first devised.

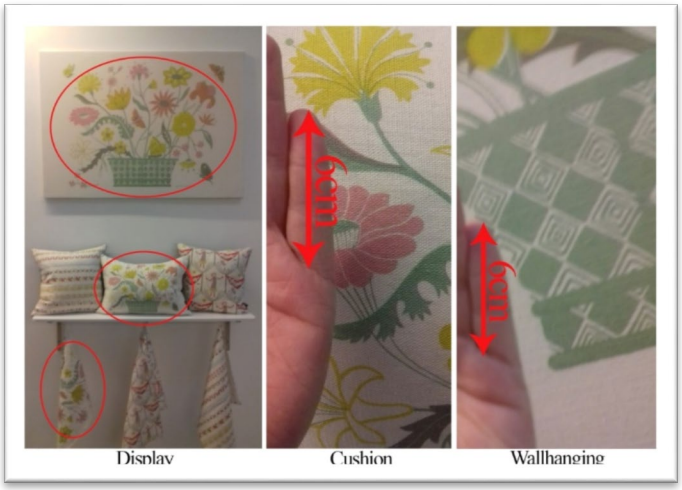

Figure 4.11 Samples printed by Classic Textiles showing scale

4.2.2 Fabric faults, Digital irregularities and Print Features

Whilst at the exhibition, the researcher had an opportunity to briefly discuss with Alan Shaw (Head of CAT). The discussion focussed on *perfection* and the benefits and drawbacks to achieving this utilizing digital printing. The researcher noted that it appears faults or original characteristics of the fabric have been smoothed out or removed for the final pieces on display. The researcher understood this is what Classic Textiles believes the consumer is looking for with digitally produced fabrics. However, digital printing does not have as much dye penetration as screen-print, on certain fabrics with a large amount of dark dye in the background, the imperfections of the process are more evident, such as with *Boats* (Figure 4.12). In addition, the digital version of *Mermaids* features the disappearance of the grey net overprint and the background meets the edge of the mermaid perfectly. These features are different on the source fabric (Figure 4.13).

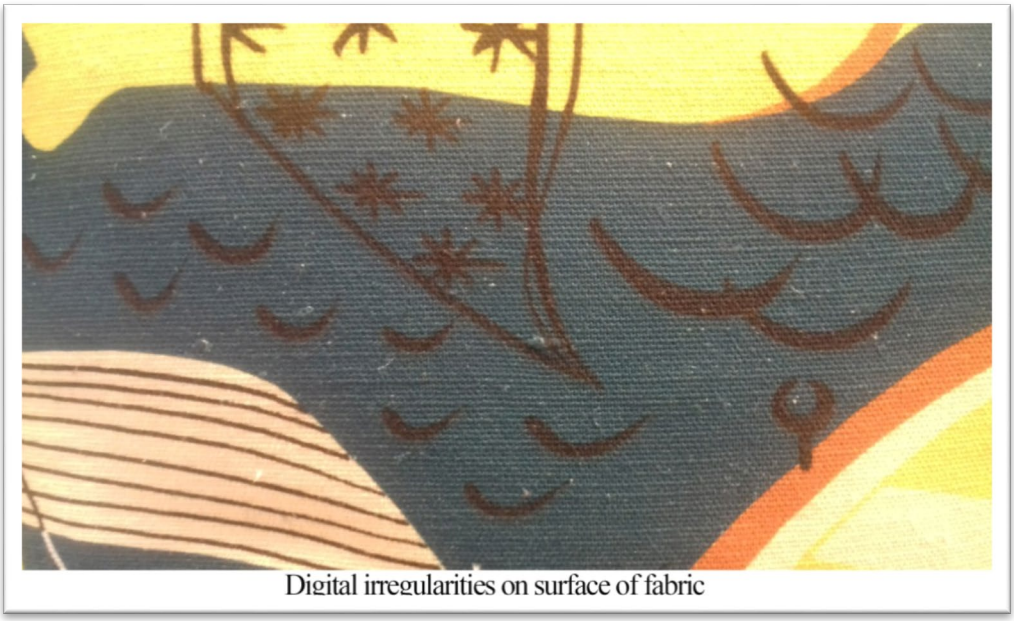

Figure 4.12 Digital irregularities on surface of fabric

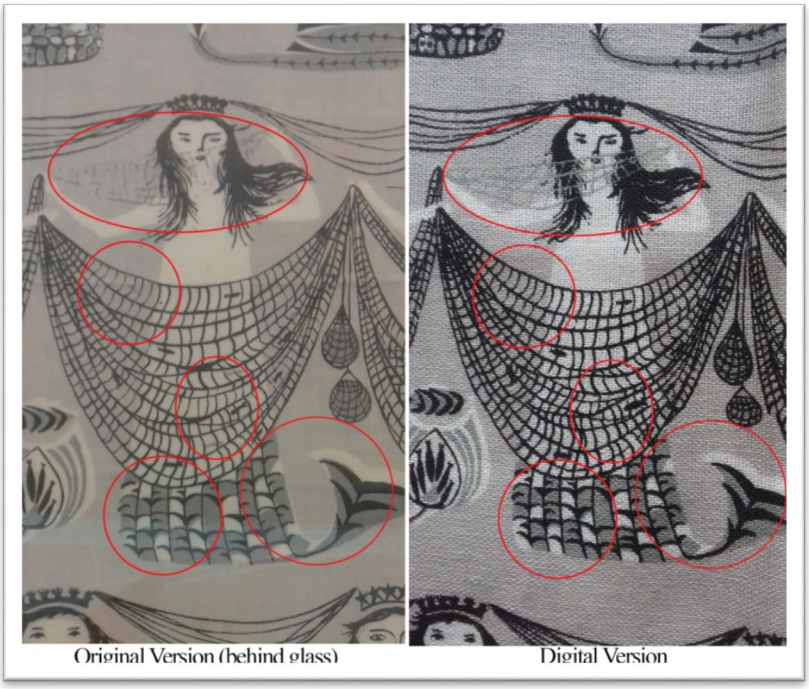

Figure 4.13 Smoothing out of design irregularities in comparison to source fabric

4.2.3 Accurate colour matching

The fabrics were accurately colour-matched, which entailed multiple test prints and comparison with the source fabrics and paintings (Figure 4.14).

Figure 4.14 Colour comparison between original and digital fabrics

4.2.4 Fabrics from original artwork

New fabrics and products were created from original drawings and paintings from the archive, which had never been made into fabrics in the 1950s and 1960s. Using digital technology allowed for original qualities and nuances to be captured which would be unachievable and undesirable during the defined era due to the limitations of the screen-print process. One of the key effects to be captured is watery ink or a watercolour effect with multiple graduations of colour or tone (Figure 4.15). Companies such as Bluebellgray (www.bluebellgray.com) utilize this effect in their work currently (Figure 2.5).

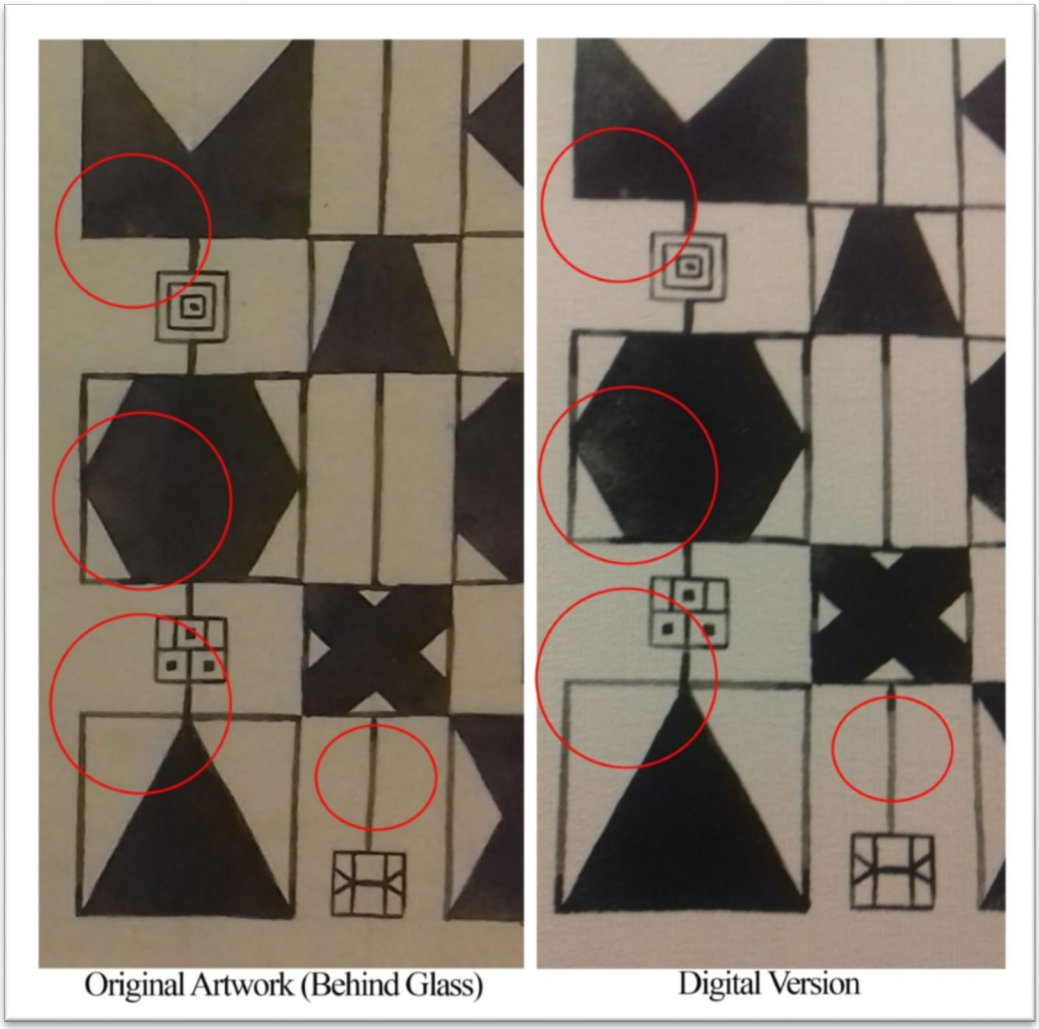

Figure 4.15 Original nuances accurately represented by digital printing (water-colour marks)

4.2.5 Substrate

All the designs were printed onto linen union fabric, both natural and white linen was used (Figure 4.16). Natural linen substrate was used for some fabrics, which were originally on a white background, and all fabrics utilized the colour of the substrate in some way within the print. *Totem*, *Twigs* and *Borders* have significant usage of the linen substrate colour. Whereas *Boats*, *Mermaids* and *Birds in a Tree* have more dye coverage and a smaller amount of the original fabric colour present (Figure 4.17).

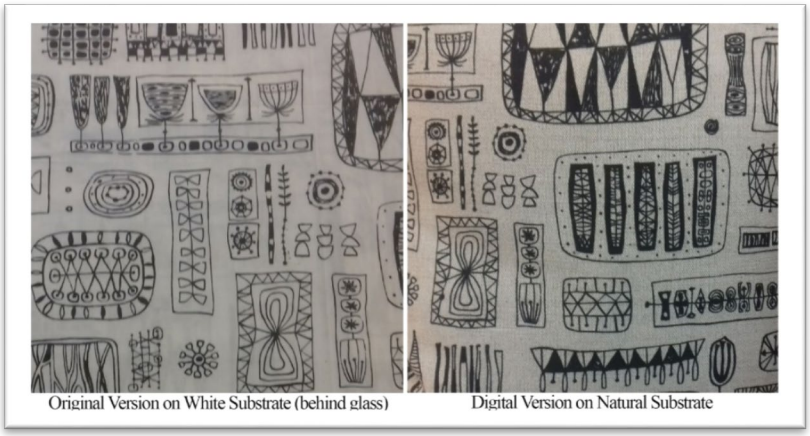

Figure 4.16 White Substrate versus Natural Substrate

Figure 4.17 Utilization of Dye and Original Substrate for different designs

4.2.6 Originals and Saleable Products

All the originals were kept behind glass, to protect the archival pieces from greasy hands and general dirt and dust (Figure 4.18). However, all the other digitally produced products and fabrics were available to handle (Figure 4.19).

Figure 4.18 Originals Behind Glass

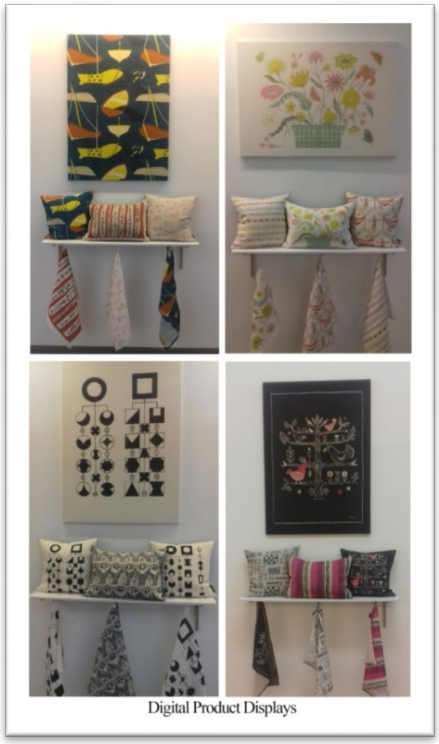

Figure 4.19 Items for sale by Classic Textiles

4.2.7 Digital Benefits

All the products and fabrics were available for the public to purchase. Very limited stock had been created for the exhibition, saving money and wastage of unsold

items. Two tea towels were ordered and printed to commission, delivered to the supplied address several weeks later.

4.2.8 Conclusion

The researcher considered the *Classic Textiles* venture and subsequent exhibition an effective utilization of archival resource and digital technology. CAT has found an approach, which benefits educational, archival and commercial application. However, the exhibition highlighted an area of exploration that could be investigated further; can the qualities of the *process* of conventional processes be captured utilizing digital technology. The following investigation intends to establish if this is possible.

4.3 Qualities to Capture

To be able to capture the qualities of a 1930s to 1950s fabric, the characteristics required identification. This process was conducted through a case study of three selected fabrics from either archival resource and purchased fabrics (Appendix B pp.163-175; C pp.176-178). The researcher necessitated that for the fabrics selected it was important historical information could be traced and the fabrics could be easily accessed for comparison purposes. The historical information required was;

- Date
- Designer
- Design Name
- Manufacturer

The fabrics selected fulfilling the requirements above were;

- *Langton* (Figure 4.20)
- *Kon Tiki* (Figure 4.21)
- *Coppice* (Figure 4.22)

Langton (Figure 4.20) is a foliage design comprised of five colours. It was screen-printed in 1937 by the manufacturer Donald Brothers. Donald Brothers was a Scottish based firm originating in the 1890s with linens for the interiors market (Taylor, 2016). It was designed by Marion Dorn. This fabric is stored at Heriot-Watt University's archiving facility at the School of Textiles and Design.

Figure 4.20 Langton Fabric Swatch from Heriot-Watt University, School of Textiles & Design Archive
Designed by Marion Dorn

Kon Tiki (Figure 4.21) is a geometric abstract pattern comprised of six colours (including the fabric colour, which is white). It was screen-printed in 1955 by a manufacturer for Liberty & Co (possibly Bernard Wardle). Liberty was a British based emporium established in 1875 by Arthur Lasenby Liberty. It was famous for its Asian inspired printed silk scarves (Chrisman-Campbell, 2013). It was designed by Hilda Durkin. The fabric was purchased online.

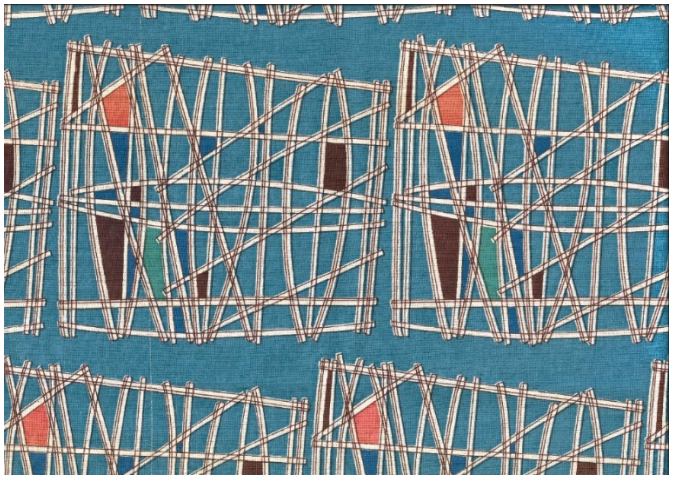

Figure 4.21 Kon Tiki Fabric Swatch from online retailer
Designed by Hilda Durkin

Coppice (Figure 4.22) is a floral abstract shape design comprised of six colours (including the fabric colour, which is white). It was screen-printed in 1954 by a manufacturer for Heal & Sons Ltd. Heal's was a bedding firm established in 1810, which moved to Tottenham Court Road also known as *'Furnishing Street of London'* in 1818. (Goodden, 1984, pp.3) Heal's is famous for delivering well-designed furniture and textiles to the masses. (Goodden, 1984). Mary White designed it. The fabric was purchased online.

Figure 4.22 Coppice Fabric Swatch from online retailer
Designed by Mary White

Analysis of the three fabrics outlined highlighted twelve qualities of a conventionally (screen or roller) printed fabric from the 1930s to 1950s (Figures 4.20, 4.21, 4.22). The qualities are described below;

4.3.1 A. Surface Print Edges/Bleeding

The edges of the separate elements constituting a pattern design might be uneven or undefined due to the print process used. Methods such as block printing or copper plate printing (intaglio) may have uneven edges owing to being cut or incised by hand (Montgomery, 1970; Briggs-Goode, 2013). A screen-printed fabric may have uneven edges due to the hand drawn nature of the elements on the drafting film used (see quality E). However, the main reason for uneven print edges or bleeding is the natural spread of dye from the design element boundary of the printed layer. The nature of the fabric can play a role in bleed effect, as a finer or absorbent fabric may allow the dye to spread further on contact, creating a less defined edge. Surface Print Edges is witnessed in Figure 4.24, where the leave joins the coral ribbon.

Bleeding is seen on Figure 4.26 where the plant motif has bled on top of the coral shape.

4.3.2 B. Print Faults

Faults may be caused by lint or other debris on the fabric, screen, squeegee, engraved roller or print block causing a barrier hindering interaction between dye and substrate. This feature can be witnessed on Figure 4.24, where the dark green ribbon appears uneven. Faults on flatbed screen-printed fabrics can be caused by screen frames lying on top of wet areas of printed fabric during the print process. This is highly problematic for *'blotch screens'* (Miles, 2003, pp.30) as large areas of coloured paste are laid down onto the fabric. Splashing of print paste can also occur, which is where the space beneath the screen remains in contact with the fabric momentarily creating a splash back effect onto the substrate (Miles, 2003). This can be witnessed on Figure 4.26 with small spots of dye present.

4.3.3 C. Print Overlay

This is also known in the industry as a *fall-on* (Chapter 4.9). The effect occurs when one design element is printed over the top of another design element and a new colour is created where overlay occurs. This can be clearly witnessed in Figure 4.24, where the mint green overlays the coral ribbon. This can be for economic reason or design purpose. For instance using fewer screens, blocks or engraved rollers to achieve more colour options or for creating interesting design features. Additionally, it may resolve the issue encountered through misregistration or gaps (G). Figure 4.26 demonstrates the colour change when printing over the same colour on top of other colours.

4.3.4 D. Fabric Texture/ Uneven Dye Saturation

An irregular pressure on the squeegee (screen-printing), an uneven surface on the pressure bowl (roller printing) or conveyor belt blanket (screen-printing) can all lead to uneven dye saturation. An irregular print surface due to the fabric construction can also lead to imbalanced distribution of dye onto the fabric. The substrate choice can also effect the visual and tactile qualities of a fabric. Textural qualities of the fabric were important during the 1930s with Potvin (2015) highlighting *sensory activation* as important. Boydell (1996) mentions substrates such as chenille, twilled

cotton and linen being utilized during this decade. However, by the 1940s and 1950s, these *textural* qualities were being captured through screen-printing (Rayner *et al.,* 2012; Breward and Wilson, 2012). Hinchcliffe (1989) highlights sturdy cottons, linens and rayons being utilized during this time. Figure 4.27 is semi-glazed cotton but there are swatches in chenille in the archive (Figure 4.23). Figure 4.25 and 4.26 are printed on plain cotton.

Figure 4.23 Langton screen-printed onto Chenille, School of Textiles & Design Archive

4.3.5 E. Hand Drawn Imagery

The introduction of screen-printing would have required artworks to be hand-cut stencils. However the introduction of photosensitive emulsions in the 1910s (Covey, 2016) allowed for hand drawn imagery to be accurately translated to the cloth. Brush and pen ink was applied to a transparent film by a technician. This allowed the characteristics, for instance uneven edges (see quality A) and brushstrokes, to be captured onto the fabric. Screen-printing allowed the designer to retain nuances of mark-making and textural brushwork, which had not been possible with copper roller printing (Rayner *et al.,* 2012). This is witnessed on all three fabrics (Figure 4.24, 4.25, 4.26).

4.3.6 F. Dye Saturation and Penetration (on reverse of fabric)

Copper roller printing and screen-printing allow more dye to be printed onto the fabric. For copper roller printing, the pressure bowl pushes the fabric into the dye. For screen-printing, the squeegee pushes the dye into the fabric. Dependent on the thickness of the fabric, the dye can penetrate the fibre and leave dye residue on the

reverse of the fabric. In the case of screen-printed (vat) dyes, this effect may be exaggerated during the fixation process, which permanently combines dye and fibre. As Briggs-Goode (2013) comments, screen-printing lay downs five times more dye than digital processes. (Chapter 4.9) This is clearly witnessed on *Langton* (Figure 4.24) as the reverse does not appear different to the face. Figures 4.25 and 4.26 also captured this quality.

4.3.7 G. Misregistration and Gaps

Misregistration occurs when a screen or roller has not been aligned (registered) to the fabric correctly. This causes a gap to appear between the different elements of the design usually of the original fabric colour. For flatbed screen-printing, this can also occur if there is inadequate adhesion of the fabric to the table and screen distortion due to excessive drag exerted on the squeegee (Miles, 2003). This is noticeable on *Langton* (Figure 4.24) and *Kon Tiki* (Figure 4.25). A gap might also be created to counteract the bleed effect discussed in quality A. Separations (design artwork) might be prepared with a small gap (1mm) between the different elements of the pattern to allow for a natural bleed. However if bleeding does not occur then a *gap* of un-dyed cloth is left around the design motif.

4.3.8 H. Fabric Faults

Faults in the fabric are a common occurrence in older fabrics that have been handled, displayed and utilized in their lifetime. The majority of fabric faults will be because of the age of the fabric rather than an issue at the original time of printing. Printing issues with the fabric at the manufacturing stage would normally be noticed by the quality controller at the factory. Issues such as pulled threads and worn areas are the visible faults identified on the case study fabrics.

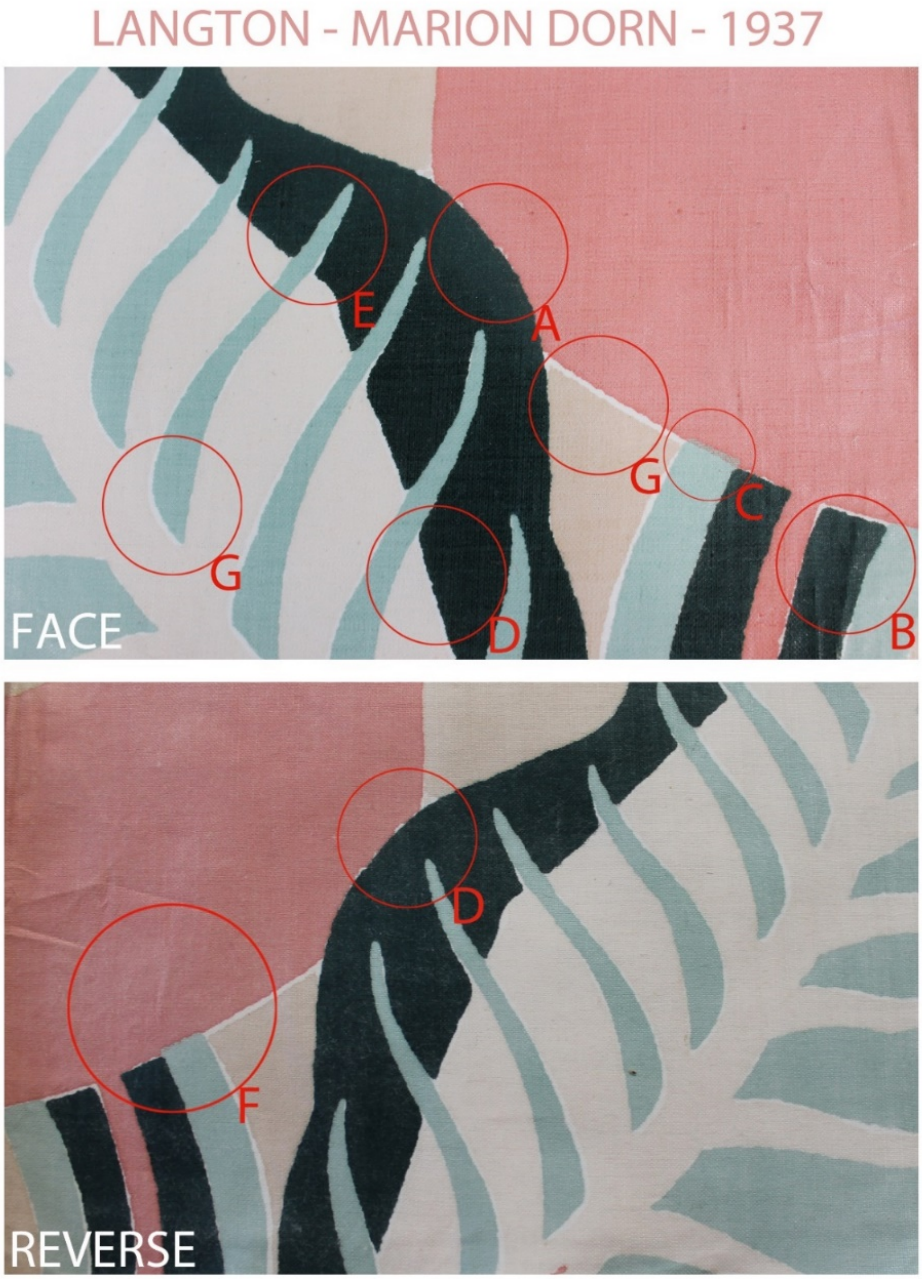

Figure 4.24 Identified qualities to capture on Langton by Marion Dorn

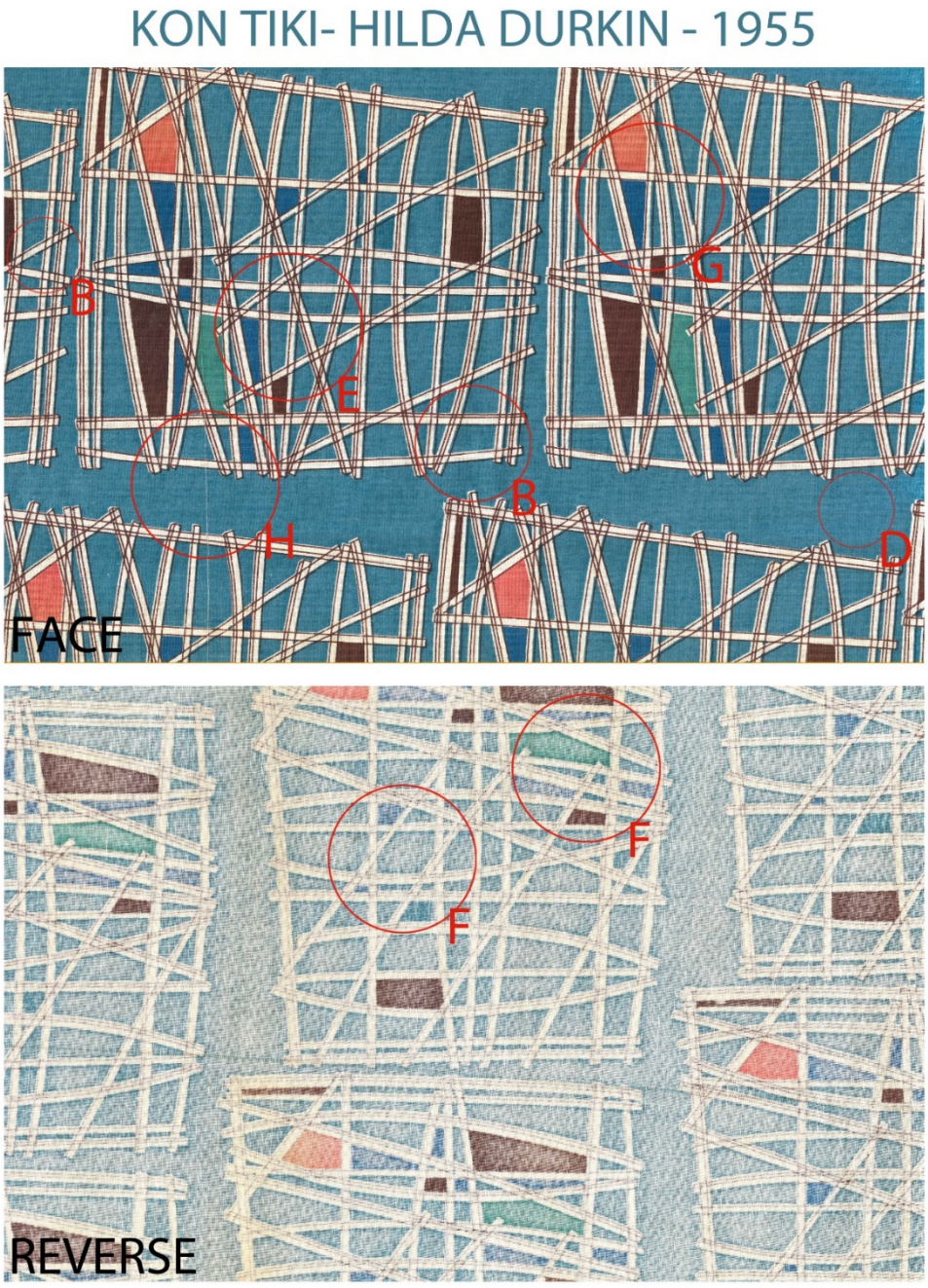

Figure 4.25 Identified qualities to capture on Kon Tiki by Hilda Durkin

Figure 4.26 Identified qualities to capture on Coppice by Mary White

The following criteria focus on characteristics that are intrinsic of any printed fabric, however the researcher focuses on the qualities that mark the fabric from the specific 1930s to 1950s era.

4.3.9 I. Colour

The dye colours selected differ dependent on the era of the printed textile (Figure 4.27). The 1930s colour palette was muted (Potvin, 2015) with a palette of browns, beiges and the occasional pastel tone utilized by designers such as Marion Dorn (Boydell, 1996) (Figure 4.24). After the Second World War, colours became more vibrant, lively and fresh in comparison to the defiant and upbeat mood of the time (Hinchcliffe, 1989; Breward and Wilson, 2012) (Figure 4.25, 4.26).

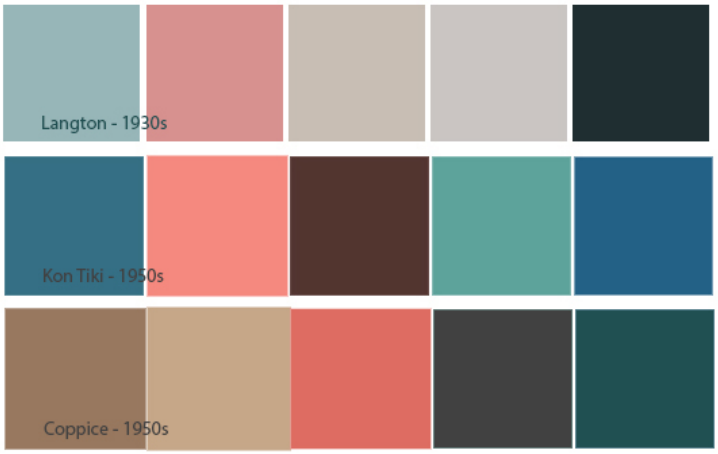

Figure 4.27 Colours from Langton, Kon Tiki and Coppice

4.3.10 J. Scale

The case studies focussed on furnishing fabrics. This equates to larger motifs, which would fill a space and create a focal point. Boydell (1996) and Douglas (1997) both comment on interior spaces. During the 1930s, the curtains or rugs could be the only pattern in a plain interior (Boydell, 1996).

4.3.11 K. Design/Motif

Battersby (1971) highlights there was still a steady demand for traditional floral patterns from 18th and 19th century during the 1930s-1950s era. However, designers such as Dorn (Figure 4.24) *stylized treatment* of motifs such as leaves brought with it a *modernist* approach, which defined the 1930s era (Boydell, 1996). The 1940s and 1950s still witnessed florals (Figure 4.26) but also abstract motifs with spindly lines

juxtaposed with nodules (Figure 4.25) (Hinchcliffe, 1989). Elements from modern painting and sculpture and scientific discovery inspired the designers of the time (Appendix B pp.163-175; D pp. 179-186).

4.3.12 L. Print Quality (separations)

The cost and time constraints of screen, roller and block printing limited the amount of separations a design would have (Chapter 4.9). Print Quality in regards to this criterion references the reduction in the amount of colours that would have been *viable* during time period. Figure 4.24, 4.25 and 4.26 have five colours. Digital printing allows for an unlimited colour palette.

Once the characteristics (A-M) had been identified, it was necessary to develop a Testing Protocol, to allow simpler identification when physical samples were produced. As can be witnessed at the testing stage and in Table 4.1, there was not set parameters for each set of test samples. The researcher allowed the characteristics to evolve naturally. The parameters became apparent after each test. Further understanding of software features and digital printer capabilities developed alongside creating the test samples. This can be witnessed throughout the development of the Findings for the investigation.

4.4 Attempting to capture the criteria - Langton

4.4.1 Testing Protocol

As discussed in the previous chapter, the researcher located and defined twelve characteristics of a screen-printed archival fabric from the 1930s to 1950s. Further to this, a series of fifteen initial tests were devised highlighted in Table 4.1. The table records the criteria the researcher was attempting to capture with each test. The researcher established two methods of achieving the criteria, witnessed in Table 4.2. These were Group 1, via manipulation on the digital software (AVA) and Group 2, via manipulation on the digital printer. Overlaps between the two groups occurred for certain criteria. These included Criteria A (Surface Print Edges/Bleeding), which the researcher attempted to achieve utilizing the *Filter Browser* on the AVA software and through the application of several layers of dye via the digital printers (see *Test 3.4.18 2, Test 25.10.17)*; Criteria D (Fabric Texture/Uneven Dye Saturation), where a selection of different filters could be applied on AVA giving the illusion of fabric

texture or different substrates could be utilized on the digital printers providing the actual texture of the fabric (see *Test 15.12.17, Test 16.4.18 B).* Whereas certain criteria were specific to the mode of application. Criteria B (Print Faults) had to be applied before the printing stage. Even though print faults occur on the digital printers, they have a different appearance as explained in *Test 9.3.18 C.* Criteria C (Print Overlay), E (Hand Drawn Imagery) and G (Misregistration and Gaps) encompassed design stage issues when utilizing digital software. Even though criteria C and G would occur at the printing stage if utilizing conventional methods, for the purpose of the research they had to be applied to the image. Essentially the researcher was trying to *fake* the appearance of these criteria, to create the illusion the fabric had been printed via conventional means. Criteria E would occur at the design stage; however, the researcher was attempting to create a *hand drawn* look utilizing digital functions provided in the software package rather than drawing the separations by hand. The criteria in *italics* would be predetermined by the fabric selected for testing, however Colour (I) would also be effected by the digital conversion and substrate selection at the printing stage.

Qualities / Test	A	B	C	D	E	F	G	H	I	J	K	L
1.28.9.17			X	X		X			X	X	X	X
2.25.10.17	X		X	X		X			X	X	X	X
3.7.12.17	X		X			X			X	X	X	X
4.15.12.17	X		X	X		X			X	X	X	X
5.29.1.18 A	X		X	X		X			X	X	X	X
6.29.1.18 B	X		X		X	X	X		X	X	X	X
7.16.2.18	X	X	X	X	X	X	X	X	X	X	X	X
8.9.3.18 A	X		X			X	X		X	X	X	X
9.9.3.18 B	X	X	X	X	X	X	X	X	X	X	X	X
10.9.3.18 C	X	X	X	X	X	X	X	X	X	X	X	X
11.3.4.18 1	X	X	X	X	X	X	X	X	X	X	X	X
12.3.4.18 2	X	X	X	X	X	X	X	X	X	X	X	X
13.16.4.18 A	X	X	X	X	X	X	X	X	X	X	X	X
14.16.4.18 B	X	X	X	X	X	X	X	X	X	X	X	X
15.16.4.18 C	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.1 Qualities attempting to capture via sampling

Group 1 (AVA)	Group 2 (Digital Printer)
A. Surface Print Edges/Bleeding	A. Surface Print Edges/Bleeding
B. Print Faults	D. Fabric Texture/Uneven Dye Saturation
C. Print Overlay	F. Dye Saturation and Penetration
D. Fabric Texture/Uneven Dye Saturation	H. Fabric Faults
E. Hand Drawn Imagery	*I. Colour*
G. Misregistration and Gaps	
H. Fabric Faults	
I. Colour	
J. Scale	
K. Design/Motif	
L. Print Quality	

Table 4.2 Method implemented for achieving the criteria

As testing progressed, it became evident that the researcher's confidence grew in the application of the criteria. In the final seven sets of samples, the researcher is attempting to apply all the developed criteria to the same sample. Discussion as to whether this was successful will be deliberated in the next section.

After each sampling, the researcher recorded the key details of the tests and drew conclusions of where to progress next (Appendix E, pp.187-212). This was aided by the Criteria Flowchart (Figure 4.28), allowing timely analysis of the swatches already produced.

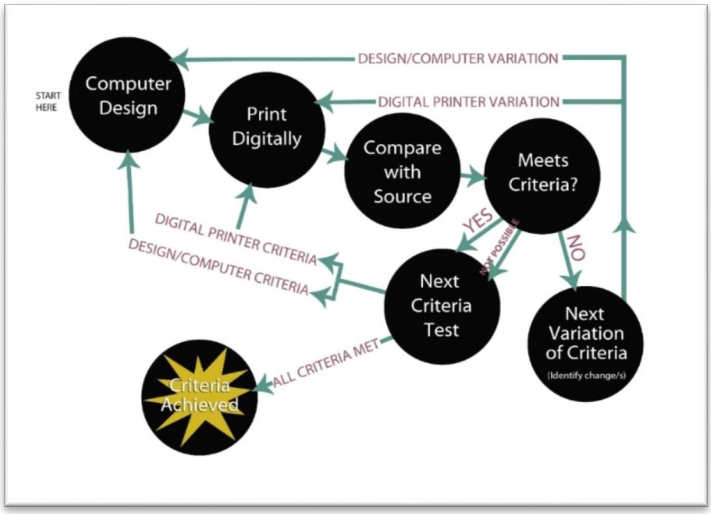

Figure 4.28 Criteria Flowchart

As can be witnessed in the criteria flowchart (Figure 4.28), both Group 1 (Computer Design) and Group 2 (Print Digitally) are accommodated.. The next section will address the creation of the initial design, *Langton*, utilizing the AVA software. Following this, a comprehensive examination of the criteria implementation and findings will be discussed.

4.5 Creating a digital version of an archival fabric

4.5.1 Initial Design

The researcher selected a fabric from the case study to utilize for the sampling stage. The *Langton* (Figure 4.20) design by Marion Dorn was chosen. The original textile available were 25cm^2 swatches, which merely encompassed a small section of the design but did provide colour (I) and fabric (D) data. However, a swatch book (Figure 4.29) detailing the specification (J, K, L) provided the necessary information to recreate an entire repeat using the AVA software.

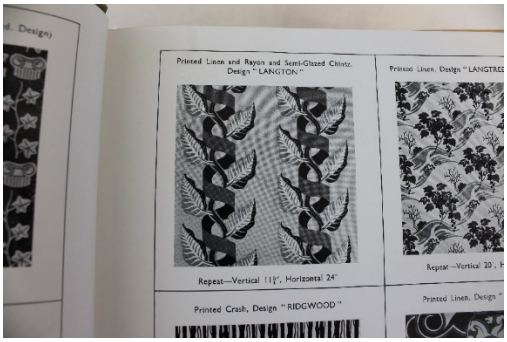

Figure 4.29 Swatch book highlighting fabric specification for Langton from Heriot-Watt University Archive

The researcher proceeded to recreate Langton digitally. To achieve this the photographs of the original swatch and repeat specification, which was a black and white image, were opened in Photoshop. Initially utilized, as the researcher did not know how to transform the image into a symmetrical image in AVA. Once this was achieved, it was saved as a TIFF file and opened in AVA for further manipulation.

Primarily, the specification tile available represented several repeat elements. One repeat required extraction to permit the use of the repeat function within the software. Once this had been completed then the user could select the quantity of repeated tiles required. The user then proceeded to select the distinct design elements referencing the original fabric image with the *lasso* selection tool. The information for each separation was recorded on a separate layer, representing the print quality criteria (L). Initially the user found the edges of the elements pixelated (Figure 4.30). This was due to the low resolution of the original scanned image. This was increased and subsequently resolved the pixilation issue (Figure 4.31). Another phenomenon to occur was colour change when two elements overlaid each other (C). Initially, the researcher did not know how this had happened however, it was a feature that they wanted to retain (Chapter 4.3). Discussion with an AVA representative confirmed this occurred due to the transparency settings on each layer, which could be manipulated individually. The background colour, which had been removed to simplify the creation of the repeat, was now reinstated as a separate layer, which would permit manipulation at a later stage (L). Certain layers were offset at this stage to create *misregistration* (G) (Figure 4.32). Finally, the colours

(I) of the original image were implemented onto the digitally recreated *Langton* print and the scale (J) set to the specified size from the swatch book.

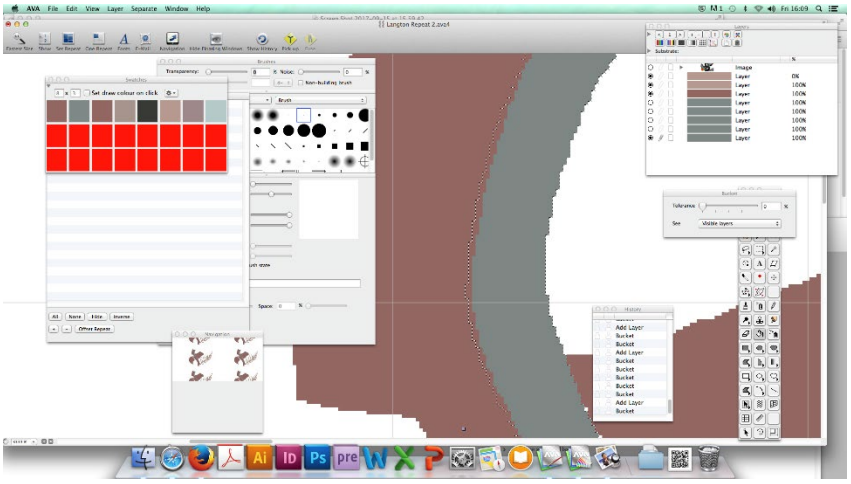

Figure 4.30 Pixelated design edges due to low resolution on AVA

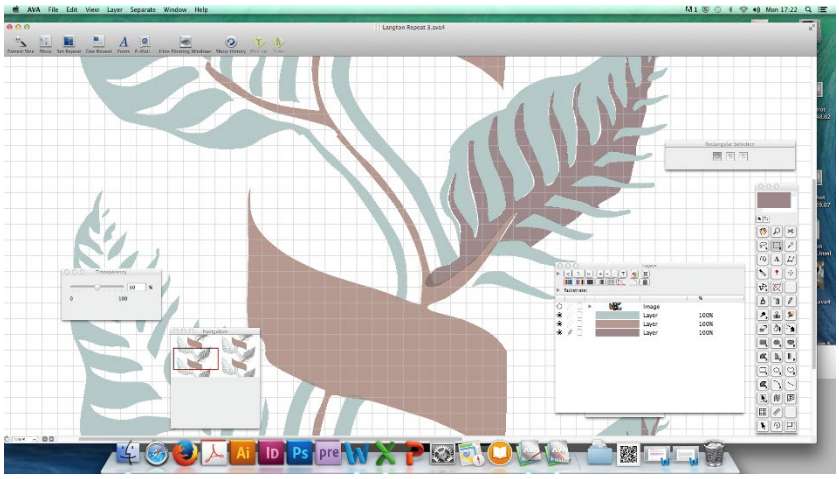

Figure 4.31 Increased resolution allowed for smoother edges of the elements on AVA

At this stage, the researcher had created an initial design to commence sampling on the digital printer. The next section comprises testing undertaken (Figure 4.32).

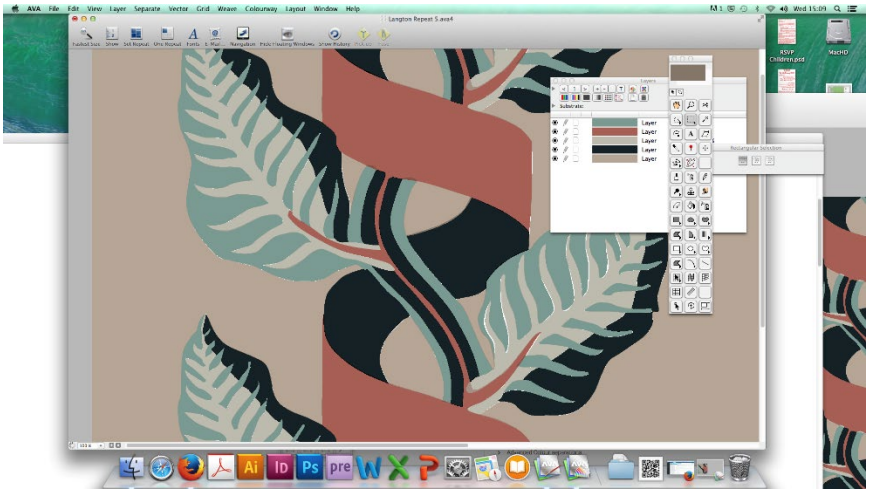

Figure 4.32 Langton design ready for digital development and sampling on AVA

4.6 Presentation of findings from testing

4.6.1 Qualities captured

The criteria A-H are the primary focus throughout testing. Criteria I-L for the purpose of this study were conducted during the Initial Design covered in the previous section. The following procedures and observations relate to the researcher attempting to capture the qualities of the qualities A-H, with reference to the other characteristics where necessary.

Qualities	A	B	C	D	E	F	G	H	I	J	K	L
1.28.9.17			0	0		0			?	/	/	/
2.25.10.17	?		?	?		/			?	/	/	/
3.7.12.17	?		?			/			?	/	/	/
4.15.12.17 29.1.18 A	?		?	?		/			?	/	/	/
5.15.12.17 29.1.18 B	?		?	?		/			?	/	/	/
6.29.1.18	?		?		0	/	?		?	/	/	/
7.16.2.18	X	X	X	X	X	X	X	X	?	/	/	/
8.9.3.18 A	?		?		?	/	/		?	/	/	/
9.9.3.18 B	/	0	?	?	?	/	/	0	?	/	/	/
10.9.3.18 C	/	0	?	?	?	/	/	0	?	?	/	/
11.3.4.18 A	/	0	?	?	/	/	/	0	?	/	/	/
12.3.4.18 B	/	?	/	?	/	/	/	?	?	/	/	/
13.16.4.18 A	/	?	/	/	/	/	/	?	?	/	/	/
14.16.4.18 B	/	?	/	/	/	/	/	?	?	/	/	/
15.16.4.18 C	/	?	/	/	/	/	/	?	?	/	/	/

Table 4.3 Qualities Criteria captured during testing on Langton

KEY	
X	Criteria to capture
/	Criteria captured
?	Criteria attempted but not captured
0	Criteria not captured

Table 4.4 Key for Table 4.3

Test 1. 28.9.17 *Dye Saturation (F)* (Appendix E.1 pp.187)

Screen-printing lays down five times more dye than digital printing (Briggs-Goode, 2013). The result is that there is not as significant dye penetration with digitally printed fabrics versus conventionally printed fabrics. This can be seen in Figure 4.33, showing the reverse of a digital and screen-printed sample.

Figure 4.33 Reverse of Digitally Printed Sample (Left) and Screen-printed Sample (Right)

After discussing this issue with the Digital Print Technician, the researcher decided investigation into the print head settings be the initial test. The Tx3 was utilized for the first test, which allows the user to alter the directional options for the printer heads (Figure 4.34). Uni-directional printing means the printer heads lay down dye in one direction, in this case right to left. Then the carriage housing the heads travels back to the start position before resuming printing. Whereas Bi-directional printing lays down dye in both directions. In addition two colourways were printed to see if this made a difference to dye saturation (Chapter 4.3).

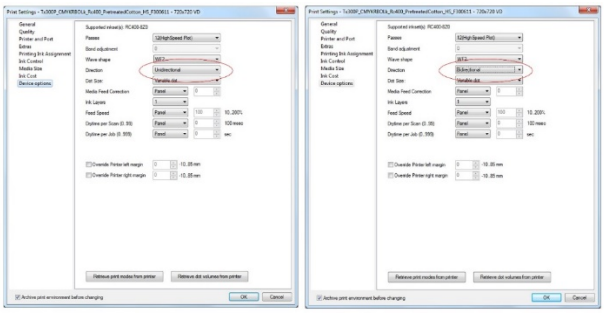

Figure 4.34 Tx3 RIP Software Printer Settings – Altering direction of printer heads

Uni-directional and Bi-directional settings produced no or little visible dye saturation and penetration difference between the samples (Appendix E pp.187). However the

darker colourway (colourway 1) did produce further penetration of the darkest colour (black) on the reverse of the Bi-directional sample (Figure 4.36). At this stage, the computer image had minimal overlaps (C) and gaps (G) present. These did not translate to the printed fabric in the intended manner, but are marginally visible on all the samples (Figure 4.35). The researcher decided that no criteria had been accomplished with Test 1. However Bi-directional head settings would be utilized where possible for future testing as the dye penetrated further into the fibre with the darker colour options.

Figure 4.35 Print Overlay (C) and Misregistration (G) present in Test 1

Figure 4.36 Uni-directional versus Bi-directional Dye Penetration on Colourway 1 & 2 – Reverse of fabric

Test 2. 25.10.17 ***Dye Saturation (F)*** (Appendix E.2 pp.188)

At this point in the testing, the Tx3 digital printer was requiring maintenance. In the meantime, testing continued on the Tx2. This machine was ten years older however offered more versatility due to the Technician's knowledge and researchers training on this machine. Another approach to achieving dye saturation was attempted (Appendix E pp.188). This method involved printing the image then rewinding the fabric and printing the same image over the top, imitating the passes of the squeegee for flatbed screen-printing. Both digital printers are supplied with plates to cover up the inkwell (Figure 4.37). The inkwell is left open for finer fabrics, to allow excess dye to go to waste, this is known as *strikethrough*. For thicker fabrics to limit sagging of the fabric, plates can be fitted over the top creating a firm surface. The researcher believed this might emulate the print bed when screen-printing. However, there was concern that if the fabric was not thick enough, there would be unnecessary transfer on the reverse of the fabric. The digital printer also has a sensor to realign the fabric if it becomes skewed. This was switched-off because the researcher did not want the fabric to realign when rewound.

Figure 4.37 Tx2 Raised Bed with Inkwell Covered (Left), Lowered Bed with Inkwell Uncovered (Right)

The design was manipulated further by adding a filter. The Surface Reticulation Filter is provided with the AVA software to provide a surface print appearance (Figure 4.38). The researcher decided this might provide an uneven surface texture

(D). The Technician recommended rewinding the fabric by 300 millimetres. This is the size of the sample for printing (250mm) plus the size of space left between new files (50mm).

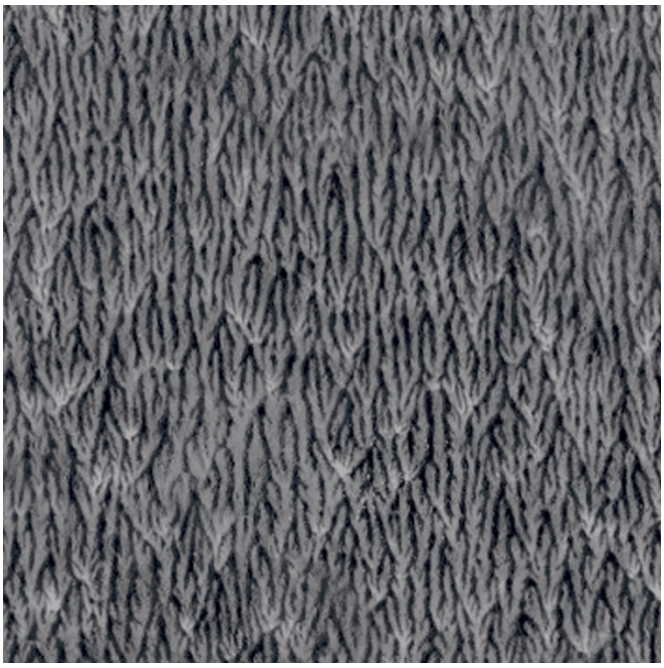

Figure 4.38 Surface Reticulation Filter (Enlarged)

Several issues were experienced. The pinch rollers guiding the fabric through the digital printer picked up dye when the fabric was rewound. This was prominent when the samples were initially printed however subsided after finishing the fabric on the design (not on the white fabric) (Figure 4.39, 4.40). It was decided to allow the fabric to dry for as long as possible in between each print. Another issue was the significant colour change. With each layer of dye, the colour (I) became darker than the source fabric (Figure 4.41). The final issue was offsetting. The 300mm rewind necessitated the overprint starting 1mm before the actual print. This created a slight offset effect on the warp /grain of the fabric (top to bottom). Exact rewind had never been required previously and it was decided that trying a rewind of 299mm could fix or semi-fix this issue. Because the researcher was using fabric rather than a rigid substrate (e.g. paper), this created issues of movement, warping, and texture. However, these issues would need to be worked with or around, as they would present a problem for anyone working with fabric.

Figure 4.39 Pinch Rollers picking up excess dye

Figure 4.40 Sample after steaming (pinch roller run off prominent)

Figure 4.41 Colour difference between source fabric and sample with four layers of dye

The researcher decided that Criteria F had been achieved by application of several layers of dye.

Criteria A (Surface Print Edges), C (Print Overlay) and D (Fabric Texture) and I (Colour) still required development. Criteria A and C had appeared with varied success (Figure 4.42). The researcher had predicted that by applying extra dye might create bleeding (A) however, it did not provide the appearance required. Criteria C was on the image was still present from the first test, however no further development had taken place. Criteria D was not present in the researcher's opinion, however comparison samples with no *Surface Reticulation Filter* would need to be printed to confirm this (see Test 3. 7.12.17).

Figure 4.42 Criteria A, C, D, I highlighted on sample with 1xpass of dye and sample with 4xpass of dye

Test 3. 7.12.17 *Dye Saturation (F) Standard* (Appendix E.3 pp.189)

Standard samples minus the *Surface Reticulation Filter* were printed to compare with Test 2. The same test protocol was utilized. It was apparent the filter provided minimal colour change/dye saturation on the face of the fabric (Appendix E pp.189). A more significant difference was witnessed on the reverse of the samples (Figure 4.43). However, the filter had not provided any extra criteria such as A or D. Ultimately, the filter had not provided anything significant that could not be achieved via application of several layers of dye by rewinding the printer.

Figure 4.43 Reverse of sample with surface reticulation (left) and without (right), both with 2x passes of dye

Test 4. 15.12.17/29.1.18 A *Dye Saturation (F) and Fabric Texture (D)* (Appendix E.4 pp.190)

The utilization of the *Surface Reticulation Filter* led to the researcher developing filters. The first filter developed was Linen Effect 1 (Figure 4.44). The filter was applied to the standard samples produced in Test 3. As the previous filter had been ineffective in providing fabric texture (D), but had aided dye saturation, the researcher anticipated that a filter devised to capture the effect of linen might be more successful. For Test 4, the filter was created utilizing the original colour. The software program automatically creates a marginally lighter shade to show the filter definition (Figure 4.45). The samples were printed in the same manner as Test 2 and 3, adding extra layers of dye by rewinding the fabric.

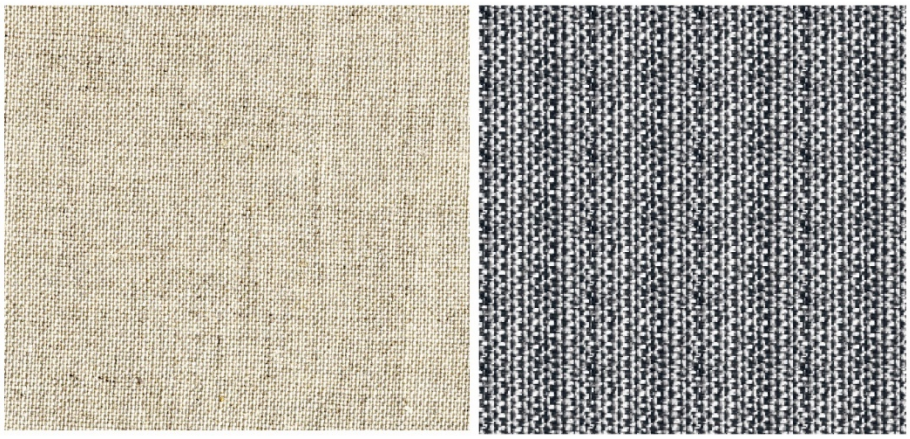

Figure 4.44 Linen Effect 1 (LE1) – original fabric (left) with created AVA filter (right)

Figure 4.45 Screen-shot of LE1 applied to Langton

Even though a *texture* is noticeable on the samples, it appears more like a stripe than a linen effect, especially when more layers of dye are added (Figure 4.46). The researcher noted that this appears like a digital print fault similar to banding when the machine is not set to a sufficient pass rate. However, in this case the striping is vertical rather than horizontal. Criteria F is still present however, D (Fabric Texture) requires further development. The other issue that occurred was layer order. Whilst applying the filter, the layer order of the image was altered. This meant that any Print Overlay (C) already present was reordered (Figure 4.47). This issue is touched upon further in *Tests 11 and 12 3.4.18*.

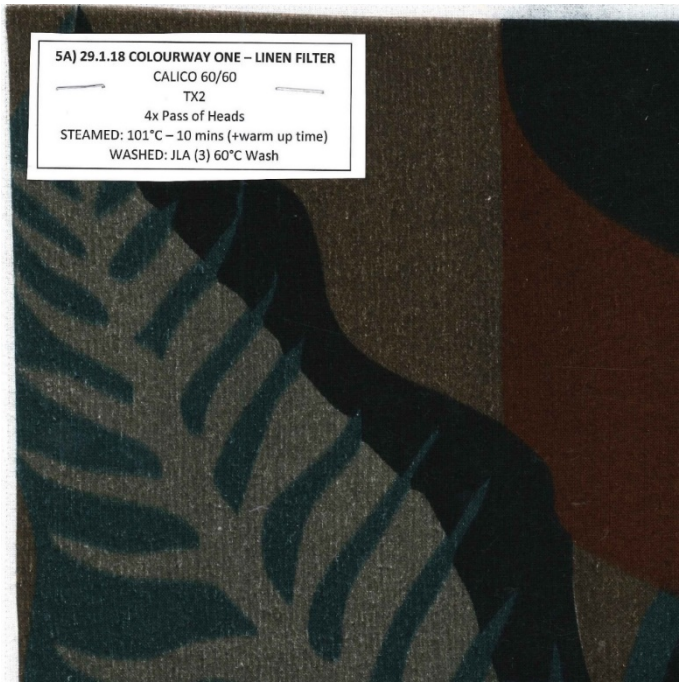

Figure 4.46 Banding effect with 4x dye passes, LE1 no longer recognisable

Figure 4.47 Layer order

No alterations had been made to achieve Criteria A (Surface Print Edges) since the previous test, nevertheless the researcher contemplated that the linen effect filter could alter the definition around the edges of the design elements. However, this was not the case.

Test 5. 15.12.17/29.1.18 B *Dye Saturation (F) and Fabric Texture (D)* (Appendix E.5 pp.191)

Test 5 utilized the same settings as Test 4, merely adjusting the colour of the linen effect. To achieve more definition, the background colour was lightened (Figure 4.48). When printed this provided a filter that appeared more like linen. However, it still formed a stripe and the linen structure became less defined on the samples with three and four layers of dye. The optimum layers of dye to retain filter definition (D) but also provide dye saturation (F) was two. Even though the filter was now providing a Fabric Texture (D), the researcher was not completely satisfied and decided that further development was required. The issues with Criteria A and C remained from the previous test.

Figure 4.48 Original LE1 from Test 4 (Left) - Lightened LE1 from Test 5 (Right)

Test 6. 29.1.18 ***Dye Saturation (F), Surface Print Edges (A) and Misregistration (G)*** (Appendix E.6 pp.192)

Even though fabric texture (D) still needed development, the researcher decided it was important not to neglect some of the other criteria, which would aid the appearance of the fabric. Misregistration was highlighted as a key quality present on conventionally printed fabrics. The researcher attempted to emulate this by offsetting the spine of the leaf. The researcher felt there was still a significant amount to do before fully achieving this characteristic; however, another issue presented itself before development. When printing several layers of dye (F), the imprecise 300mm measurement caused a *double vision* effect on prints 2 and 3 (Figure 4.49). The amount of dye on 4 passes negated this issue as the dye bled between the elements hiding the effect. However as it had been decided in Test 5 that two layers of dye was optimum, then the *double vision* effect would need rectifying, as it presented itself as a digitally created fault rather than a characteristic. It was decided to attempt an exact rewind (299mm) in the future.

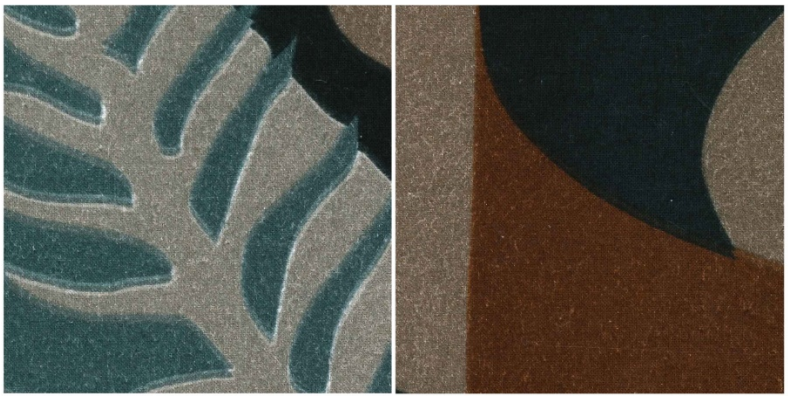

Figure 4.49 Double Vision effect caused by inaccurate rewind

Further investigation was conducted on Criteria A (Surface Print Edges). The researcher had learnt that the filter browser could also be utilized to change the edges of an element, not just the pattern inside the element. Implementation of brush stroke edges did soften the edges of the elements (Figure 4.50). However, this was only visible on very close inspection or in comparison to a previous sample without this feature. It was also considered that *brush-stroke edges* could provide a hand-drawn (E) appearance however, this did not occur for the same reasons as discussed.

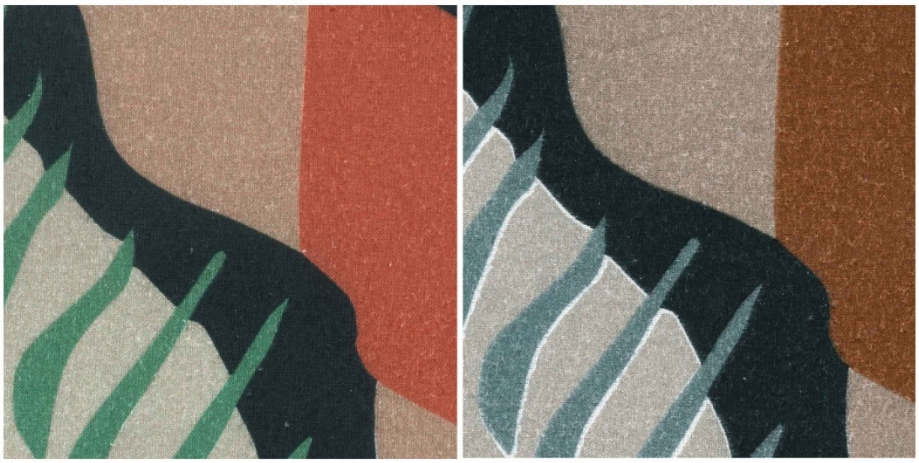

Figure 4.50 Brush-stroke softened edges (right) compared to Test 1 (Left)

Test 6 provided a step forward in the investigation. The majority of criteria had not been successful to this point however; the sample was beginning to resemble the source in several ways. At this point, development was required for criteria A, C, D, E and G. The other criteria had not been implemented at this stage.

Test 7. 16.2.18 *Screen-Print Tests* (Appendix E.7 pp.193)

Screen-printed samples were created for comparison purpose. Undergoing the screen-print process provided a clearer understanding of the quality of specific criteria. The approach was similar to the flatbed process of the 1930s-1950s era. Five separations were created by tracing the design onto drafting film using rotring ink and paintbrush (Figure 4.51). (Admittedly, this was done from a photographic image of the original rather than from a drawing). Registration marks were applied to allow the researcher to match the separations when printing. The researcher decided that an exact colour match to the original was not necessary; however, a colour resemblance would be helpful (Figure 4.52). Reactive dye was chosen, as it is the same as the digital printers. Three fabrics were chosen;

- Calico 60/60
- Shantung Silk
- Wexford Cotton/Linen

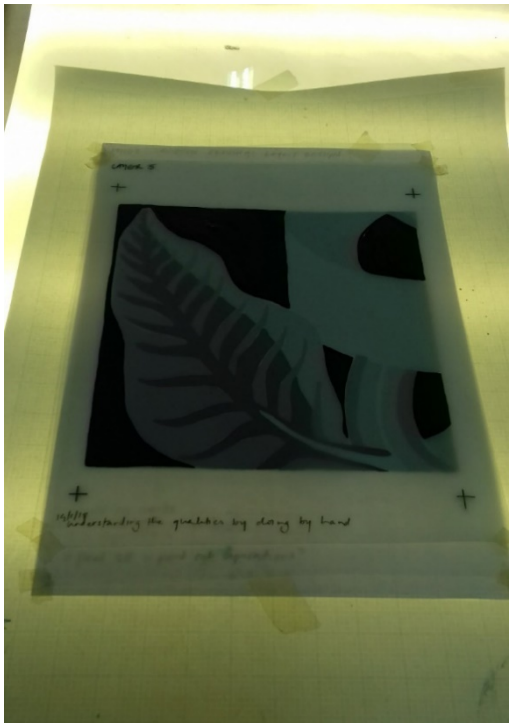

Figure 4.51 Creating separations for screen-printing

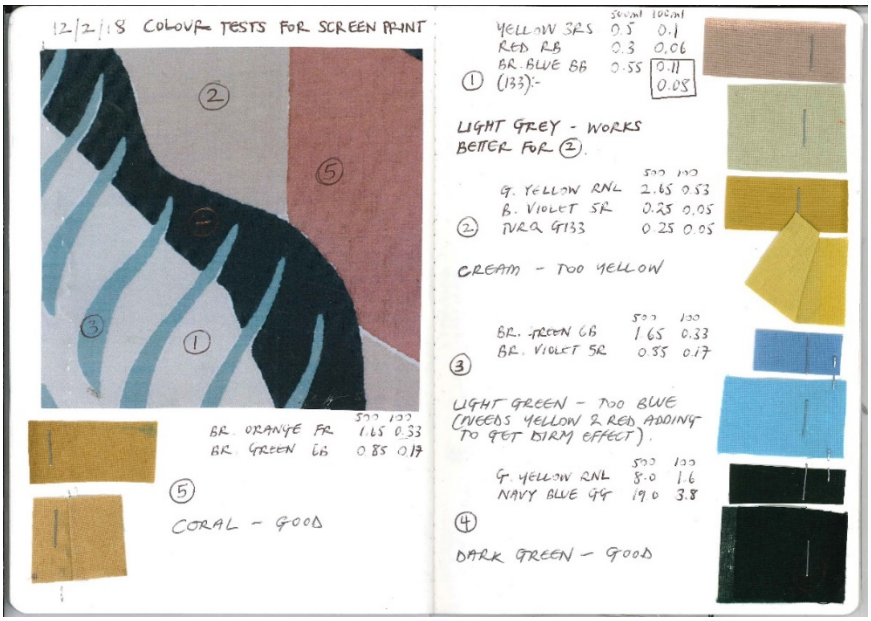

Figure 4.52 Colour mixing from Journal

A to L were captured in some way across the three samples (Figure 4.53). By printing onto a textured cloth would assist in the decision to continue the filter onto the base of the fabric in the Jungle Tests. In addition to creating more, prominent gaps between the design elements.

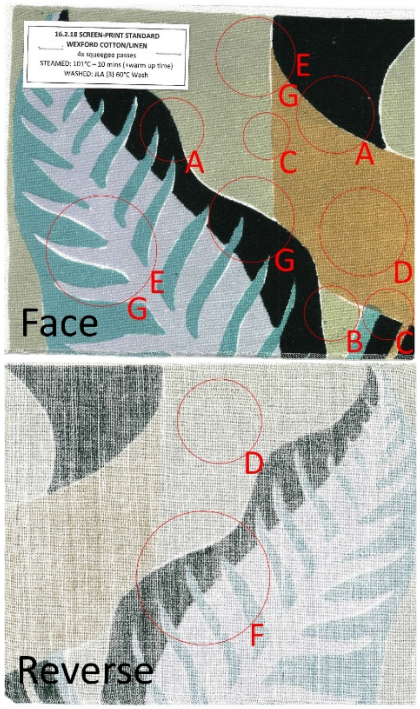

Figure 4.53 Criteria highlighted on screen-printed wexford sample

It was noted that the colour of the dye changed dependent on the fabric. However, in theory the same dyes are utilized for digital printing so the same phenomena should occur. The other important feature was the print layer order. When printing by hand, layer order can affect the final appearance. In this case, Colour 7 was printed last to *fall-on* Colour 5 (Figure 4.54). This became important when deciding the layer order on AVA, as touched upon in Test 4. This will be further discussed in Test 11 and 12.

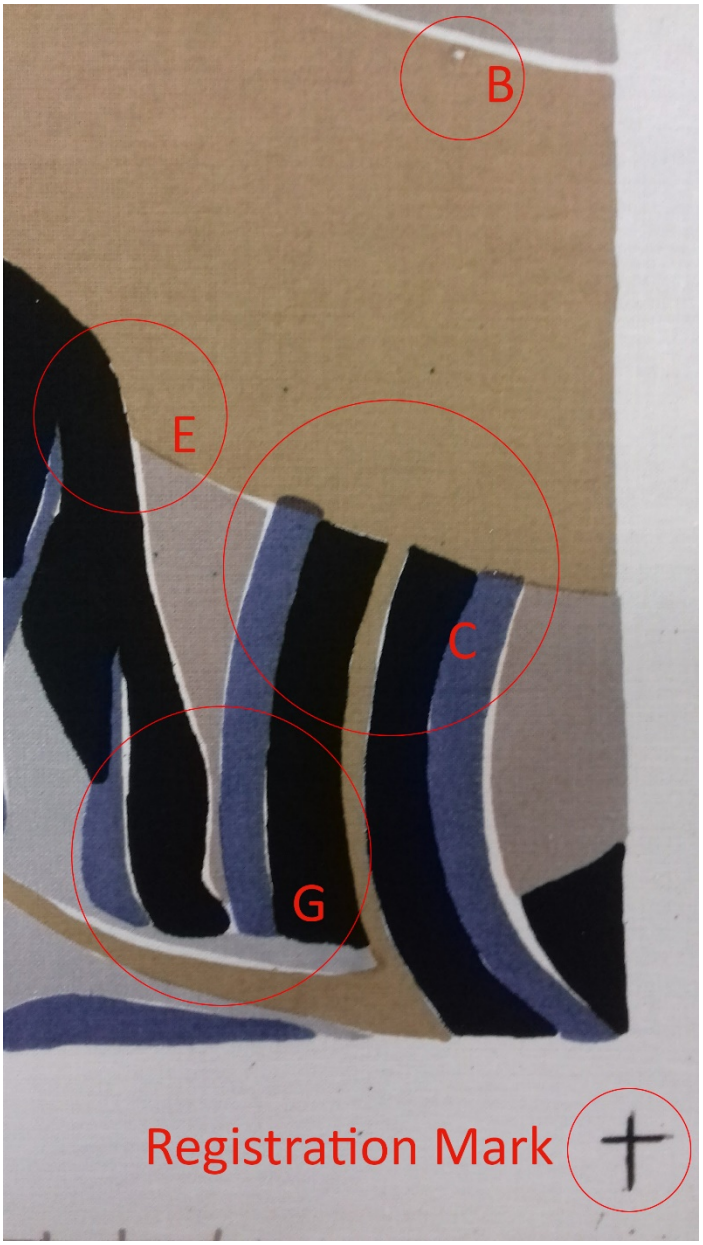

Figure 4.54 Colour 7 fall-on Colour 5

Test 8. 9.3.18 A *Misregistration (G) and Dye Saturation (F)* (Appendix E.8 pp.194)

Following on from the discoveries attained in the previous test, focus was once again applied to Criteria G. As witnessed in Figure 4.55, the creation of prominent gaps (G) encouraged print overlay (C). Sharp corners were rounded off, which would happen if the separations were created by hand (E), in line with the results in Test 7. The overprint rewind was 299 millimetres and provided an accurate outcome versus Test 6 (Figure 4.56).

Figure 4.55 Test 8 – Prominent Misregistration (G) encouraged Print Overlay (C) and sharp corners were rounded off (E)

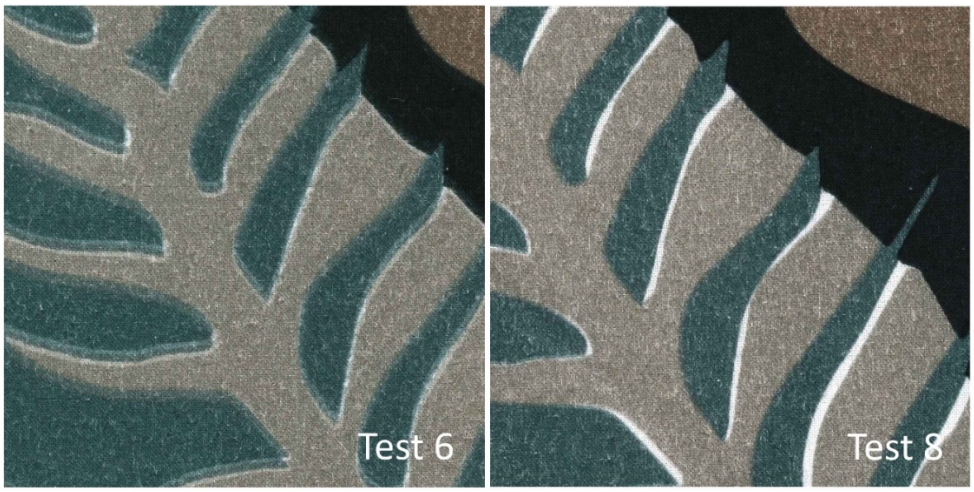

Figure 4.56 Test 6 with 300mm fabric rewind versus Test 8 with 299mm rewind (2 passes of dye)

Test 9. 9.3.18 B *Misregistration (G), Fabric Texture (D) and Dye Saturation (F)* (Appendix E.9 pp.195)

Linen Effect 2 (LE2) (Figure 4.57) was created to emulate the surface reticulation filter and LE1 combined. For instance, the filter provided by AVA translated to paper but not fabric. Criteria A could be achieved by altering *Gaussian Blur* on the filter browser then offsetting before filling. However, LE2 was hindered by the fabric choice, which appeared textured after finishing had taken place. It was decided to test other fabrics to see how this effected the filter (Test 12). The samples with the filter did appear darker than in Test 8. The filter was offset to make the edges less defined (A) which worked in certain areas (Figure 4.58). However, this

also made the misregistration (G) less pronounced (Figure 4.59). Combining all these criteria together with F also squandered the effect of D and G. Overall, progress was being made, however the researcher discovered that altering or adding certain characteristics negated the effect of previously achieved characteristics. These issues had to be worked through on a case-by-case basis when they arose. The key issues at this stage were;

- choice of substrate
- off-setting filter (A) concealing misregistration (G)
- applying extra layers of dye (F) concealing fabric texture (D) and misregistration (G)

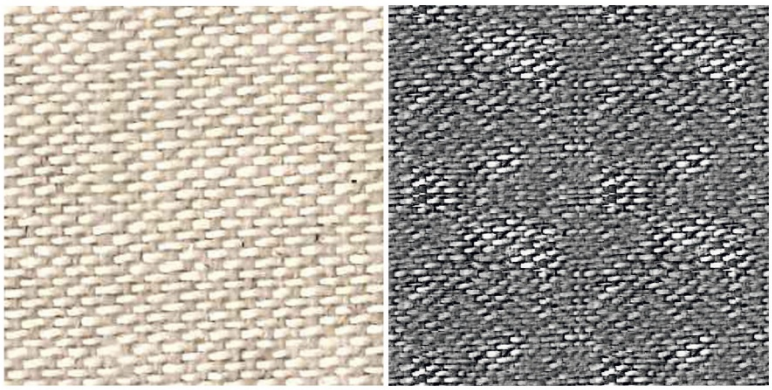

Figure 4.57 Linen Effect 2 – Original fabric (left), Created Filter (right)

Figure 4.58 Criteria A and G highlighted on Test A (no filter – left) and Test B (with filter – right)

Test 10. 9.3.18 C *Misregistration (G), Fabric Texture (D) and Dye Saturation (F)* (Appendix E.9 pp.195)

The image was enlarged to 400%, which also enlarged the filter (708x708pixels). The filter was now visible on the substrate. The researcher realised it had not been visible on previous samples due to its size. Other characteristics such as A, D and G were more visible because of the increased zoom. However, dye spotting (Figure 4.58) presented as a digital fault.

Figure 4.59 Dye spotting circled on right

Test 11. 3.4.18 A *Fabric Texture (D), Surface Print Edges (A), Dye Saturation (F), Print Overlay (C) and Hand Drawn Imagery (E)* (Appendix E.10 pp.197)

LE2 was enlarged to 400% (D) and offset (A) creating uneven edges and in certain areas, print overlay (C). Test 11 was printed onto Calico 60/60. The filter was visible compared to Test 9 however; the researcher still believed the substrate was altering the final appearance. The uneven edges also provided a hand drawn feel (E) to the image. (Figure 4.60)

Figure 4.60 Test 9 (left) compared to Test 11 (right)

Test 12. 3.4.18 B *Fabric Texture (D), Surface Print Edges (A), Dye Saturation (F), Print Overlay (C) and Hand Drawn Imagery (E)* (Appendix E.11 pp.197)

This test was printed onto Cotton Poplin. The filter was more prominent of this substrate versus the Calico 60/60 as suspected. As discussed in Test 4 and 7, the layer order was finally explored further in Test 11 and 12 (Appendix E pp.198). The screen-print layer order uncovered details that the digital print order hid. For instance, the edge of the black leaf has an uneven appearance compared on the screen order versus the digital order (Figure 4.61). At this point, the researcher felt that criteria A, C, E, F and G had been achieved. Even though there was Fabric Texture (D), the researcher felt it was important to visualise the two created filters layered over each other. Criteria B and H were the most difficult to capture and due to time limitations, it was decided to discard them at this stage. However, the researcher did consider the introduction of LE2 had achieved this idea of *faults* to a certain extent, especially with the uneven edges (Figure 4.62).

Figure 4.61 Digital Print Order (left) versus Screen Print Order (right)

Figure 4.62 Final samples on Calico 60/60 (left) and Cotton Poplin (right)

Test 13, 14, 15. 16.4.18 A, B, C *Surface Print Edges (A), Print Overlay (C), Fabric Texture (D), Hand Drawn Imagery (E), Dye Saturation (F) and Misregistration (G)* (Appendix E.12-14 pp.198-200)

The final three sets of samples explored the utilization of three different substrates with all the criteria applied in Test 11 and 12 additionally Linen Effect 1 from Test 4.

Test 13. Printed onto cotton poplin. Rub off on sample A3 was visible from rewinding the fabric however this issue is concealed by the application of the filters in future samples (Figure 4.63). The researcher believed that Test A.6 had achieved A, C, D, E, F and G. The definition of D is marginally lost when two layers of dye are applied to achieve F however; certain compromises were required to achieve the

overall visual effect. It was also felt that E was not achieved to any extent; however, that was due to the original archive fabric selection rather than the application of criteria.

Figure 4.63 Pinch roller overprint visible

Test 14. The above criteria were applied to Wexford cotton/linen. The effect of the filters was lost in the complexity of the structure however, other characteristics were retained. For instance, overlay (C) and surface edges (A). Essentially the criteria that was absent (D) was replaced by the texture of the actual fabric.

Test 15. The final set of samples in this test series were completed on Calico 60/60. The researcher introduced a new colourway; however, this was surplus to requirements at this stage. Consequently, it also presented another issue with digital printing; haze on certain colours (Figure 4.64). Contact with outside technical help was pursued however; it was an issue that could not be fully explored due to the time

limitation. Lint also posed a difficulty with the Calico, as it left small white gaps on the fabric. Nevertheless, it was found lint removal before application of extra passes of dye corrected this issue.

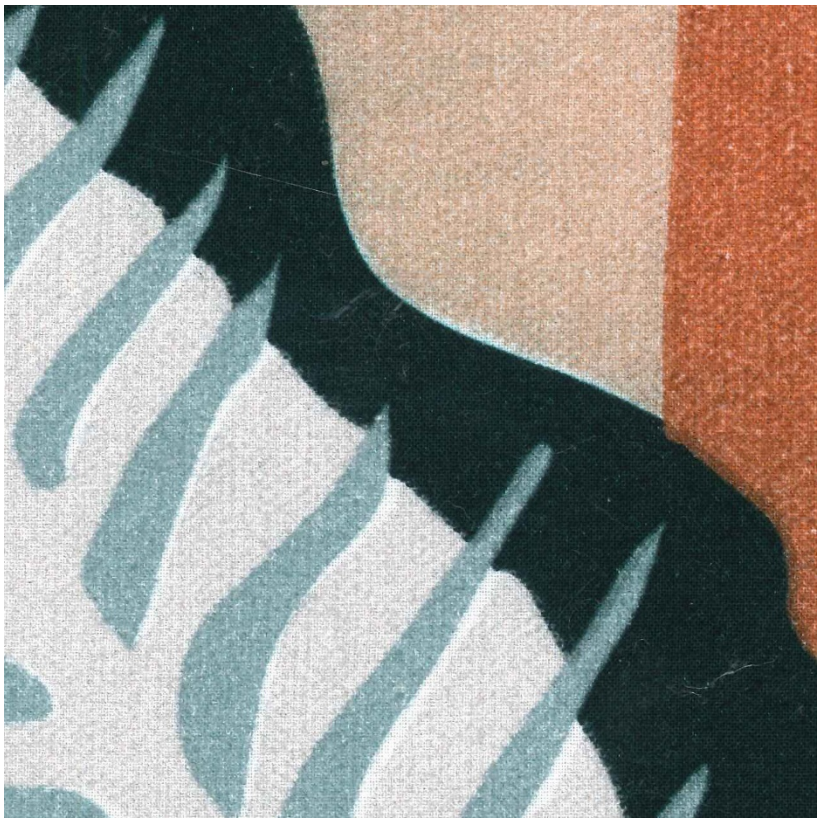

Figure 4.64 Hazing on Colourway 3

At this point, the researcher believed that this process of testing could continue indefinitely. The test notes in the appendix refer to the possibility of creating brushes and altering colourways for further investigation. However to allow the investigation to progress, it was decided to proceed to new parameters. This entailed the application of the defined criteria onto a digitally created design. This would allow the researcher to witness if the developed criteria turned a digital *look* into a traditionally printed appearance.

4.7 Application of criteria to digital design

This section concentrates on application of criteria to a digital design. Testing on the *Langton* print had allowed the researcher to develop a series of characteristics representing a traditionally printed fabric through digital application. The second series of tests focussed on applying the developed criteria to a digital design

establishing if a traditionally printed appearance could be achieved on a digitally created design.

Two final year Design for Textiles degree students from Heriot-Watt University supplied their digitally produced designs to work with. Permission was sought and gained to utilize the design work within the thesis (Appendix G pp.216-217).

The design *Jungle* was selected as an appropriate starting point. The researcher had assumed that application of the characteristics could commence immediately, however this was not the case. Supplied as a flattened Photoshop file (.PSD), the designer had utilized a significant colour palette (18 colours) and other digital effects such as transparency. These features are not inherent of a fabric from the 1930s to 1950s era. It was necessary for the researcher to utilize AVA as a screen-printer to reduce the amount of colours and create the design into separations before any developed characteristics could be applied.

Firstly, *Jungle* was converted to a TIFF file to make it compatible with the AVA software. Eighteen colours were pinpointed and selected (Figure 4.65) using the pipette tool. A solid colour layer was created for each one, this included white as the substrate colour.

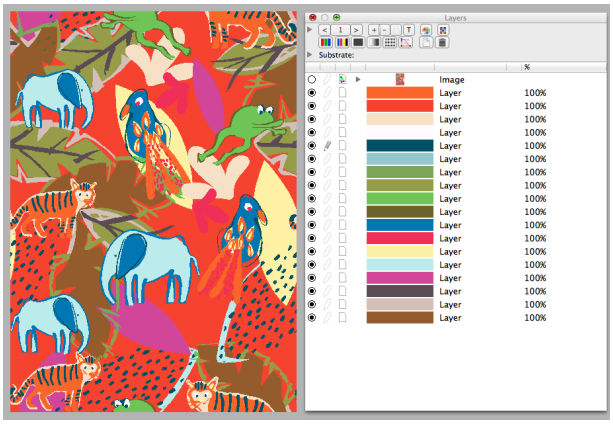

Figure 4.65 Selection of 18 colours from original design

Utilizing the *separation* functions on AVA allows each colour to be separated into individual layers of information. Initially *Auto with create* was tested. This allows the user to decide *how many colours* and the software decides the *optimum colours* within the user's palettes. Figure 4.66 demonstrates this function. However, it was

discovered that the software selects based on depth of colour rather than hue. This meant that certain unrelated shapes/motifs were combined, for example the outline of the elephant's ear, leaf stem, leaves and tiger stripes. In addition, due to the small amount of visible white/base substrate, this disappeared altogether. In theory, it is possible to screen-print onto a coloured base fabric but the majority of base fabrics in industry are neutral, rendering them appropriate for a variety of end-user applications.

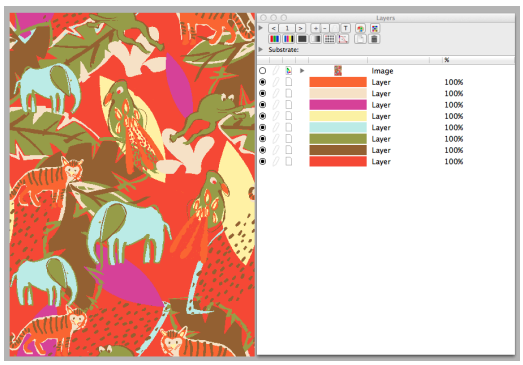

Figure 4.66 Colours selected with Auto with Create

The second option, *Automatic Separation*, proved successful. This function allows the user to select the colours for separation. Once complete, the eighteen different colours present were reduced down by hue rather than colour depth by the user. This posed a lengthier process overall however allowed more control over which colours to combine together to not affect the appearance of the design. The design was reduced down to nine colours, including the base substrate (Figure 4.67). The other issue was *noise* (unwanted colour spots) (Figure 4.68). This was corrected by using *Despeckle* on the Filter Browser.

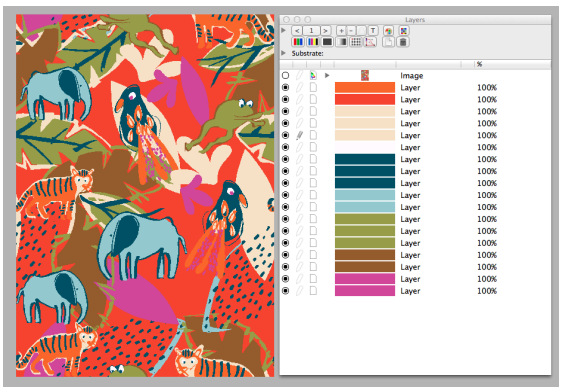

Figure 4.67 Reducing 18 separated colours down to 8 (plus substrate)

Figure 4.68 Red Layer with noise (left) and without noise (right)

The other feature that required reintroduction was the completion of design elements, which had been split up during the separation process (Figure 4.69). The completion of these elements, for instance the pink leaves, suggested the Print Overlay (C) criteria when all the layers were active. This would create the appearance of *fall-on* present in traditionally printed fabrics, for example, the completed pink leaf would alter the colour of all the elements printed on top of it (Figure 4.70).

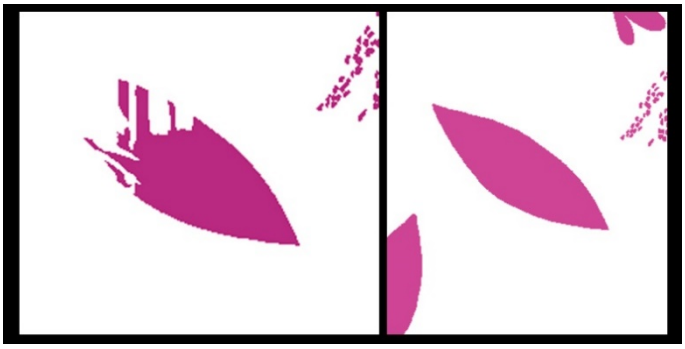

Figure 4.69 Uncompleted element (left), completed element (right)

Figure 4.70 Overlaid pink leaf on frog creating colour change

Once this process was complete, the researcher could apply the Qualities Criteria established during the previous tests (see Appendix E pp.201-212). It was assumed that all the issues had been resolved at the initial testing stage. However, the application of the criteria to *Jungle* highlighted issues that had been resolved previously, such as layer order, misregistration and scale, as new problems when applied to a contemporary design.

Firstly, *Langton* had only comprised of five colours, whereas *Jungle* contained eight. The researcher screen-printed *Langton*, which provided an appropriate layer order however; limited time meant it was not possible to print *Jungle* in the same manner. With four additional colours to contend with, it was necessary to discern an appropriate layer order to achieve the *fall-on* effect.

Secondly, a decision was required on how many layers to misregister. It would be unlikely that more than one or two separations would be misregistered if traditionally printed and consequently offsetting one separation would result in adjoining elements appearing misregistered. This had not been an issue with *Langton* because the original swatch already had misregistration present. However, *Jungle* presented an *accurate* representation of the original designer's intentions to create a digitally printed fabric.

Thirdly, the matter of scale presented a variable for contention. Whereas *Langton* was enlarged to witness what happened with the applied filters, the original scale was recorded in the swatch book. It seemed appropriate to enlarge the scale of *Jungle* to imitate a traditionally printed furnishing fabric, as the majority of source fabrics from the archive had been upholstery fabrics, which are a larger scale. However, the researcher also considered it appropriate to print some samples at the supplied size, to establish if scale altered the appearance of the digitally applied characteristics as well as altering the perception of era. The researcher had already witnessed what happened when scaling up an upholstery sized design, however *Jungle* had been designed for the apparel market and due to this had smaller design elements.

These three variables resulted in significantly more samples being produced than originally intended (Appendix E pp.187-212). This resulted in several observations,

- Linen Effect 1 provided authenticity to the overall appearance of the sample. However, scaling the filter to 300% by accident (Figure 4.71) also provided a vintage feel.
- Colour performs an important role in creating the appearance of a 1930s to 1950s fabric. The bold contemporary colour palette provided by the original designer overpowered the applied criteria.
- Misregistration (where the design element is offset) provides an intentional fault created by human error, which is a necessary characteristic of a traditionally printed fabric from the era. However, Gaps around design elements characterize a feature that is expected in current rotary screen-printing.

- Scale is an important feature of a 1930s to 1950s upholstery fabric. These types of fabric had larger imagery. Firstly, because of the difference in size between a person and an interior. Secondly, because the process of creating a screen-print by hand would be limited by the technician's dextral skill. This would have also led to the print overlay at the edges of a motif, where the technician did not quite achieve an exact match.

Figure 4.71 Scaling the filter to 300% provided a vintage appearance to the fabric sample

As previously mentioned (Chapter 4.5), the software and digital printers were utilized simultaneously to create the desired outcome. Whereas the characteristics mentioned above focussed on the digital manipulation in the software, there was also a development with the digital printers, which led to several more samples being produced. Tests 2 - 15 utilized the Tx2 in the same manner as previously mentioned. However, towards the end of the project, the Tx2 was requiring maintenance, so the researcher returned to the Tx3 machine to print Tests 16 – 22 (Appendix E pp.202-212). The newer digital printer does not behave in the same manner as the older machine. It is not possible to select *leaf* to deactivate the sensor if utilizing a fabric on a roll. This meant that when rewinding the machine, the sensor realigned the fabric and created significant offset on the sample (Figure 4.72). However, the researcher discovered that it was possible to reset the *ink layers* in the RIP software printer settings. This led to several extra samples being printed to witness how this changed the amount of Dye Saturation (F) (Appendix E pp.202-212).

Figure 4.72 Offsetting due to Tx3 realignment sensor

A final *Jungle* print was developed considering the above observations and sample results. It was reduced to five colours in line with the *Langton* sample (Figure 4.74). The *ink layers* were set to three. Figures 4.73 and 4.74 highlight the characteristics retained within Sample A (*Langton*) and Sample B (*Jungle*). These samples were subsequently utilized within a Questionnaire to establish if the characteristics the researcher considered captured had been achieved.

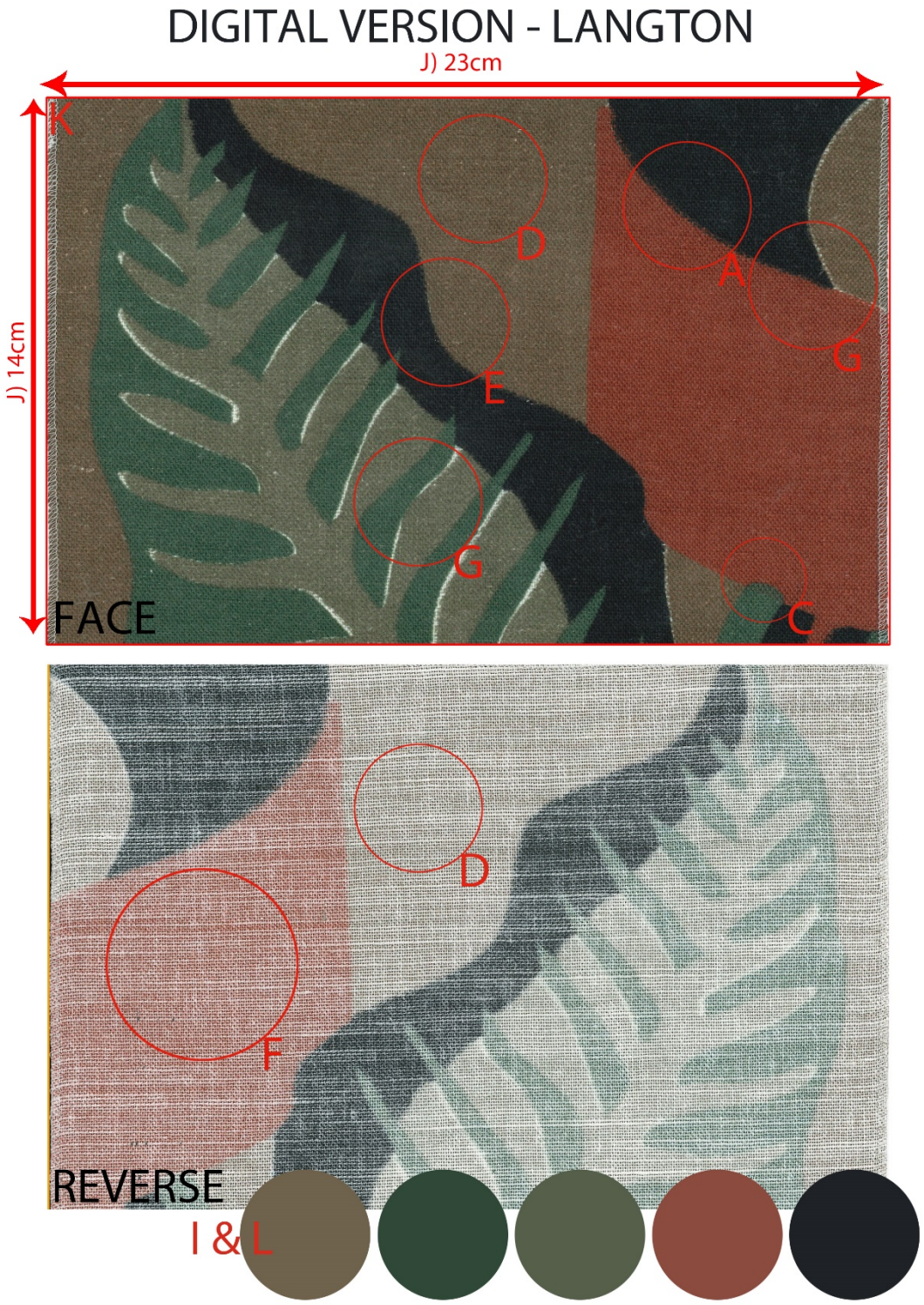

Figure 4.73 Sample A – Langton - Qualities captured according to the researcher

Figure 4.74 Sample B – Jungle - Qualities captured according to the researcher

4.8 Questionnaire

Throughout the testing of *Langton* and *Jungle*, the researcher considered the subjective nature of establishing whether a criterion had been achieved not as robust as originally thought. Subsequently, the researcher developed a questionnaire with accompanying samples to gather data from a range of people. The questionnaire comprised fifteen questions. Questions one through four covered personal information. The other questions related to the samples provided (Figure 4.75).

Figure 4.75 Sample A (Left) and Sample B (Right) sent to Questionnaire Participants

For the purpose of the questionnaire, the words *archival*, *vintage*, *old* and the words *contemporary*, *modern*, *current* were grouped together in a similar context. This allowed the researcher to ask a wide demographic of participants to take part. Ethics Approval was gained. Twenty-two questionnaires were distributed to willing participants; twelve responses were received in the required timeframe.

The first four questions covered the participant's age, location, background and current employment. The researcher considered these relevant as each one could alter their perception of archival fabrics and understanding of the subject of textiles as a whole.

4.8.1 Age

There was an even distribution of participants aged from 18 to 64. The researcher did not receive responses from people aged below 18 and above 64. However, the researcher believed that this presented opinions from a range of different aged respondents (Table 4.5).

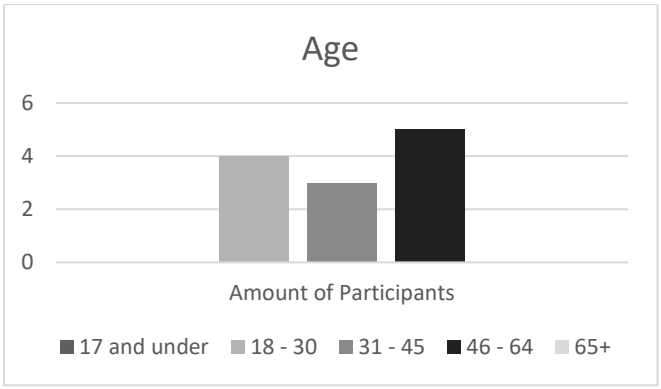

Table 4.5 Participants Age

4.8.2 Postcode

This was to establish where the participants currently reside. Due to the limited timeframe, all the participants were from the UK. The majority were based in Scotland. However only 3 were local to the investigation origin (Table 4.6).

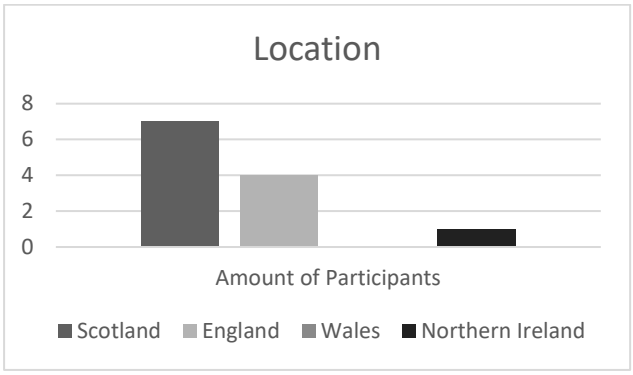

Table 4.6 Participants Location

4.8.3 Background and Current Employment

This established whether the participant had any previous or current knowledge of art, design or textiles through previous experience or current employment that would inform their answers. All but one of the participants either had formal training or an informed understanding of art, design or textiles or currently worked in a relevant industry. However, participant 8 stated that they had none of the above (Table 4.7).

Participant / Knowledge	1	2	3	4	5	6	7	8	9	10	11	12
Background	X	X	X	X	X	X	X		X	X	X	X
Current	X	X		X	X		X			X	X	X

Table 4.7 Participants Textile Background and Current Employment Status

4.8.4 Sample Assessment by the Questionnaire Participants

The following eight questions were in reference to two samples provided. The researcher attempted to devise questions that provided enough information to require relevant answers but did not lead the respondent to answer in a particular way or highlight any of the characteristics the researcher had formulated earlier on in the research. The participants were asked to supply their opinion as to what the features were and explain how it affected the samples appearance of *archival*, *vintage*, *old* or *contemporary*, *modern*, *current.*

4.8.5 Question 5a. and Question 5b.

Q5a. Which features make Sample A look archival/vintage/old? (Please provide a minimum of 3 characteristics if possible)
Q5b. Please explain your reasoning behind the answer above?

Criteria / Participant	A	B	C	D	E	F	G	H	I	J	K	L	Other
1	x		x	x		x	x		x	x	x		Linen, Furnishing/Interior, slub, weave
2				x				x	x			x	Texture, slubs, worn, linen
3				x			x		x		x	x	Quality of print, fabric slubs
4		x	x	x			x		x			x	Limited colour palette, natural dyes
5				x			x	x	x				Slubs, heavy fabric, uneven texture

6				x			x		x			x	Woven substrate, solid colours, limited colours
7				x					x		x		Rigid forms, feel (of fabric)
8					x				x	x			Curves, shape, 1950s, upholstery
9				x					x	x	x		Linen, Barkcloth, 1950s, interiors (1970s)
10									x		x		Feel, Linen
11				x	x							x	Cloth, quality of print, Block Print, unprinted areas authentic, natural fibres
12							x		x		x		Fabric structure, 1970s

Table 4.8 Sample A - Criteria A-L mentioned by the participants

Sample A was *Langton*, which had been manipulated to appear screen-printed even though it had been digitally printed for the Questionnaire. It was printed onto Wexford Linen/Cotton. All the criteria were mentioned by at least one participant. However, there were characteristics mentioned numerous times (Table 4.8).

The most popular answers eluded to Fabric texture (D), Misregistration (G) and Colour (I). Participant 1, 9 and 10 mentioned linen by name. Whereas participants 1, 3, 4, 5, 6, 11 and 12 eluded to slubs, weight and construction of the fabric.

Participant 1 mentioned;

'…linen dishcloths handed-down to me by my Granny…curtains in a bedroom I had as a child'

As well as;

'…many fabrics I have seen in Galleries and Museums' (e.g. V&A, Geffrye Museum)

Participant 5 highlighted;

'Heavy weight of fabric with uneven texture suggests the fabric was made with older processes'

Participant 6;

'…uneven spun yarns'

Whereas Participant 12 responds with;

'In am not sure why the open structure makes me think 'old''

Misregistration (G) was mentioned by half the respondents. Participants 1, 3, 4, 5, 6 and 12 mentioned offsetting or misaligned as making Sample A appear *archival, vintage, old.*

Participant 4 mentions;

'…misalignment of colour blocks/overlapping of colours'

Participant 5 states;

'…offset print suggests screen-print method'

Participant 6 explains further;

'…offset suggested that it was printed using traditional screen printing technique as it happens when the screens are not align properly between colours'

Participant 3 did not realise they had identified misregistration because they believed the sample to be screen-printed;

'Is this an older screen print? Are the white lines imperfections?'

The most mentioned characteristic was Colour (I). Eleven of the respondents indicated the feature within their response. Only Participant 11 did not mention colour preferring to concentrate on texture and print quality.

Participant 2 says;

'…selected colour palette…used…in more retro/older prints'

Participant 3 mentions;

'…older colour palette'

Several of the participants (4, 5, 6, 7, 9) mentioned the dark or muted colour palette. Participant 8 linked it to the 1950s and Participants 9 and 12 compared it to 1970s. However, Participant 9 also mentioned the fabric choice as reminiscent of the 1950s.

Participant 12;

'…reminds me of 70s earth tone colour palette'

Whereas, Participant 4 provides more detail as to why the chosen colour palette links to *archival, vintage, old;*

'Colours used not too vivid – replicate natural dyes colour range'

'Natural dyes have limited colour range, often more dull greens, brown available before vivid range of colours became more widespread with synthetic dyes'

Other characteristics which were highlighted by several participants included Design (K) and Print Quality (L) and three participants emphasised Scale (J).

Participants 1, 3, 7, 9, 10 and 12 all mentioned the Design (K) of Sample A as a feature that made it look *archival, vintage, old*. Whereas Participants 1, 3, 7 and 10 mention design in a general way, 9 and 12 provided more detail;

Participant 9;

'The pattern of leaves could come from past times'

Participant 12;

'…leaf/floral prints have been used in old/vintage designs many times'

Print Quality (L) was stressed by participant 2, 3, 4, 6 and 11. Participant 4 only referenced 'more traditional hand printing techniques' whereas 3, 6 and 11 pinpointed either screen-printing or block printing as possible techniques or imitated processes.

Scale (J) was only used an explanation by Participant 1. However, Participant 8 and 9 both referred to 'upholstery' or 'interior', which denotes a larger scale of print.

Characteristics A, B, C, E, F and H were only mentioned by two or fewer participants.

Surface print edges/ Bleeding (A) was mentioned by Participant 1;

'…the way…colours…are bled on other colours'

However, this could as easily refer to Print Overlay (C), which was highlighted by 1 and 4. Nevertheless, Participant 4 also referred to Print Overlay (C) as a Print Fault (B) and was the only person to make a connection in this way. In reference to Hand Drawn Imagery (E), Participant 8 referred to 'curves' and 'shape' with Participant 11 referring to block printing and a 'smooth transition between colour blocks'. However, this could also tie into Print Quality (L). Characteristic Fabric Faults (H) was mentioned by participants 2 and 5. Participant 2 said;

'…seems textural, slight slubs appearing on the fabric makes it appear worn (distressed look)'

Finally, Dye Saturation (F) on the reverse of the fabric was only mentioned by Participant 1 alongside the overall effect of several other characteristics combined.

4.8.6 Question 6a. and Question 6b.

Q6a. Which features make Sample A look contemporary/modern/current? (Please provide a minimum of 3 characteristics if possible)
Q6b. Please explain your reasoning behind the answer above?

So not to lead the participants into believing that Sample A was from a certain era, the researcher asked them what they found contemporary/modern/current. The participants found this question difficult as is witnessed in the reduction of information provided versus Q5. However, interesting notions about current trends and the revival of past trends in modern settings was highlighted as well as motif and current printing techniques.

Participants 1, 2 and 8 mentioned current trends;

Participant 1;

‘The Swiss Cheese leaf motif is also becoming “retro fabulous” & having a moment again’

Participant 2;

‘Block print – current trend at the moment’

Participant 8;

‘…vintage look is becoming more modern and current’

Four of the participants (1, 2, 5, 7) commented on the motif or the design of the fabric.

Participant 7;

‘Big scale of the motif with forms taken from geometrics and floral makes this design more modern’

Two of the participants mentioned the lack of degradation especially with the colour and fibres.

Participant 4;

‘…all 3 aspects (lack of degradation of fibres/yarns, no fading on dark colours, crispness of the white colour) relate to ageing of fabrics and perceived degradation that we expect to see on older fabrics. Something about the crispness and finish of the fabric gives a new look’

Participant 11 mentioned the appearance of the reverse side and lack of saturation with Participant 5 pointing out it was digitally printed.

Participants 3 and 12 did not believe there were any features that eluded to the fabric being modern/contemporary or current.

4.8.7 Question 7a. and Question 7b.

Q7a. Which features make Sample B look archival/vintage/old? (Please provide a minimum of 3 characteristics if possible)
Q7b. Please explain your reasoning behind the answer above?

Criteria / Participant	A	B	C	D	E	F	G	H	I	J	K	L	Other
1					x				x		x		Lithograph, 1950s
2				x					x		x	x	Amount of layers seen in older designs
3							x		x		x		Inaccurate printing, basic animal shapes
4	x		x						x				Less clean/bleeding of ink, same palette as A, overlapping colours
5					x		x		x				Muted colour, hand drawn, offset, rough edges
6							x		x				Offset
7									x		x		Rigid forms
8									x		x		Animal print, different texture to A
9	x			x					x		x		Pattern has blurry feel, material feels old style
10									x		x		Stylised animals and leaves, whimsical, leaf background similar to A
11													None
12				x					x			x	White block print lines, open knitted fabric structure (appears like it is printed on different fabric), 1970s colour

Table 4.9 Sample B – Criteria A-L mentioned by participants

Sample B was the *Jungle* design, which had all the developed criteria applied to it. It was printed onto Cotton Poplin. Not all the characteristics were mentioned. These included Print Faults (B), Dye Saturation (F), Fabric Faults (H) and Scale (J). However as discussed in the previous chapter, B and H, the researcher believed had been difficult characteristics to achieve (Table 4.9).

Only Colour (I) and Design (K) were mentioned by several of the participants. Colour (I) was most popular with only one participant (11) not mentioning it. The same respondent could not find any features that made the fabric appear archival/vintage/old.

Participant 1 referenced;

> 'The "Baby poo" ochre colour'

And Participant 4 mentioned 'natural dye' again and it being the same colour palette utilized in Sample A. Participant 4 and 8 were the only ones to make this connection. Participants 5, 6, 7, 9, 10 all eluded to either dark, muted or dull colour in the sample, with Participant 12 mentioning a 1970s colour palette. Participant 1 mentioned the ochre shade suggesting 1950s colour.

Misregistration (G) was highlighted by 3 participants (3, 5, 6). Participant 3 called it 'inaccurate printing' and Participant 6 called it 'offset'. Participant 5 mentioned offset of the print but also suggested the rough edges of the design eluded to 'suggesting it was not designed on a computer' characterised by Hand Drawn Imagery (E). Participant 1 also mentioned this criterion;

> 'The quality of the Black lines suggests to me a quality of Lithographic Printing rarely used today'

Participant 2 mentioned *layers* denoting an understanding of the screen-printing process and subsequently Print Quality (L). Criteria A (Surface Print Edges/Bleeding) was mentioned by Participants 4 and 9, which was one more than for Sample A. However, the chosen substrate was thinner than Sample A and would allow this feature to be more prominent.

4.8.8 Question 8a. and Question 8b.

Q8a. Which features make Sample B look contemporary/modern/current? (Please provide a minimum of 3 characteristics if possible)
Q8b. Please explain your reasoning behind the answer above?

The respondents provided a range of features relating to several different topics. Similar to Q6, some of the participants made links to current trends within the design. Six of the participants (3, 6, 7, 9, 10, 12) stated the design or pattern appeared *contemporary/modern/current.* Participants 3, 6, 9, 10, 12 all cited different motifs within the design.

Participant 9;

'…naïve elephants – contemporary for nursery or tropical sitting room'

Participant 12;

'The shapes of the leaves and animals seem to be of a more contemporary style of drawing'

Participant 9 also mentioned the 'fashionable dark colours' and retro being in fashion this season. Which referenced vintage styles being in vogue currently.

A recurring comment was on the fabric itself. Ten of the Participants (1, 2, 3, 4, 5, 6, 7, 8, 10, 11) mentioned either the weight, feel or type of fabric utilized. Four of the participants mentioned the fabric appearing or feeling synthetic or man-made with Participant 8 surmising the feel of the fabric was 'more current'. Participant 1 mentioned weight and composition, whereas Participant 7 mentioned drape and Participant 11 commented on the close weave and the 'thin and flimsy' feel appearing more modern, concluding with 'obviously digital stock'.

Several participants (2, 3, 5, 6, 11, 12) mentioned or eluded to digital printing or digital techniques. Whereas 2, 5, 6, 11 stated appears or is digitally printed, Participant 3 referenced 'modern techniques' and 12 eluded to it with the comment;

'…more volume of colours because it is easier to have a larger amount with technology in printing'

In addition, 2 and 6 also referenced either number of layers or colours would be difficult to achieve with traditional methods.

Some of the participants (1, 4, 7, 10, 11) highlighted the features developed specifically for the investigation. Participant 1, 4, 7 mentioned the added texture, with 1 commenting;

'…under-printed texture is less flat/straight-forward/simple in appearance'

Participant 4 revealed the texture to be too 'precise' as well as;

'…overlapping of certain elements look intentional rather than error'

'…misplacement of some colours is more extreme and looks to be part of the designer's intention'

Participant 11 mentioned the edges of the coloured blocks suffering because the design had been enlarged too much. Along with Participant 1, they both mentioned the dense black dye saturation on the face and reverse of the fabric.

Finally, Participant 10 summed up by comparing 'skilled artisan craftsmanship' with 'vintage/archival'. They felt the 'slap-dash' feel of Sample B went against this notion. Commenting on a specific feature the respondent said;

'…deliberate wide edges around leaves and stems feels more modern, 'rebellious', 'provocative' than my concept of vintage which carries a meaning of 'careful craftsmanship' in it'

Following the questions specific to the samples, the researcher believed it important to establish what the respondents' opinion of retaining archival/vintage/old characteristics in current outcomes.

4.8.8 Question 9a, Question 9b and Question 9c

Q9a. Do you think it is important to retain characteristics from archival/vintage/old printed textiles to influence a current design based outcome?
Q9b. Please provide further explanation to your answer if you can.
Q9c. Please provide examples of context if you can. (E.g. are there any examples you can think where archival/vintage/old features have been utilized within textile, art or design based outcomes)

All the participants responded positively to Q9a. Participant 1 mentioned it would be dependent on the intended use of the design. Whereas Participant 9 revealed retaining the charm and detail of original patterns but updating colourways for 'contemporary living'. Participants 2, 3, 4, 5, 6, 9, cited aesthetic characteristics being influential in current design.

Participant 2;

'…we will always be inspired by design that has passed…old/retro is a current trend – always inspiring and a time to celebrate what design has and can do'

Participant 4;

'…authentic characteristics bring a new level of interest to current designs'

Participants 1, 4, 6, 8, 10 and 11 eluded to the archive resource or the importance of conservation either as the original or as a replica.

Participant 1 asked and answered their own question;

'Do I think it's important to have access to the resources? Yes, absolutely!'

Whereas Participant 11 was 'torn' between 'conserving the original' and 'preserving content' which they believed 'key to achieving public interest'. They continued to state;

'Ultimately I am resigned that conservation will only be able to achieve its aim for so long hence your project is essential. I am pleased that this questionnaire seems to be looking at how best to deliver the whole experience with modern materials…otherwise you may as well just print patterns on paper or just digitise on screen'

This provided positive encouragement to the researcher. Participant 10 also provided clarification over the importance of the physical artefact;

'…even though pictures exist, they cannot communicate the real deal…The viewer/artist/designer misses the sensibility they get from a synthesized experience of the fabric that was used by the original designer'

'…to rely on photographic or modern printed references would be like letting automotive designers only looking at photographs of vintage cars rather than getting to touch and experience them with all the senses'

Finally, the researcher requested examples of context, as in design based outcomes past and present that have utilized *archival, vintage or old* influences. This provided a clearer understanding as to participants' considerations versus that of the researcher. The majority of the examples were known to the researcher and made sense in the context of the project. They included Cath Kidston, Orla Kiely, Liberty, Sandersons, Designers Guild, St. Judes and Marimekko to name a few. Participant 4 mentioned more generalised 'vintage fashion, wallpapers' and along with Participant 8 considered the actual archival resource of surviving historical clothing and conservation work as being current contextual outcomes.

Further analysis and discussion of the questionnaire findings can be found in Chapter 4.11.

4.9 Interview

The researcher had an opportunity towards the end of the investigation to interview two employees at a Printworks in the North of England. Due to the researcher's inexperience, it became a dialogue between the researcher and interviewees. However, a significant amount of data was retrieved which proved beneficial in providing further understanding of;

- The characteristics and terminology of traditionally and digitally printed textiles
- The benefits and limitations of digital processes versus traditional methods
- The utilization of archives within the Printworks
- The issue of copyright

4.9.1 The characteristics and terminology of traditionally and digitally printed textiles

The company was founded in 1835 and began with hand block printed fabrics. Interviewee A explains about the process below;

'You can see here the amount of work involved (Figure 4.76). *They were real craftsmen. This is a 22 colour pattern. I think there were 88 blocks. 88 blocks to create one repeat of the pattern. And he had to repeat that to get pieces (3 yards of fabric). That's how much work was involved. We made our own blocks. It was a real craft'*

Figure 4.76 Block-printing at the Printworks in the 1830s (John Hambleton)

A variety of natural dyes and mordants were utilized by the print works to achieve a variety of colours, as well as *second course* work explained below;

'...different type of things went on to get certain shades. As well as this, they also did second course work. They would print 4 or 5 colours and then when the piece was dry, when they finished the length, they would take the piece off the table, get it steamed, fetch it back to the table, lay it back down again and add more colours to it. That is unbelievable. In some cases, you know what cloths like, they would have to move the fabric a little bit to get the block on. The main thing was to get the shades'

The bespoke nature of this process had a significant following, as the printworks was willing to go to such lengths to achieve such variety of colours and patterns. As discussed further by Interviewee A;

'That particular pattern…is in Balmoral...the original design is from 1897 (Figure 4.77). *You can see here that they put so many colours in, and then they steam it and then put some more colours in. It's in this book and you can see how they did it…if you look at some of the complications of how they achieved shades, where you get fall-ons (a colour sitting on top of another colour)'*

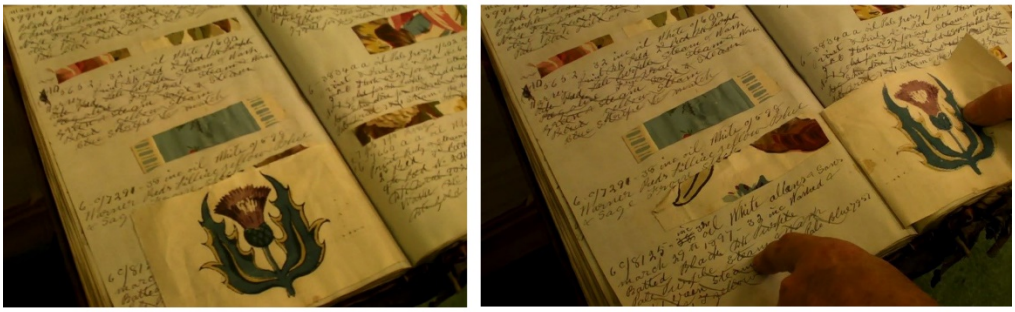

Figure 4.77 Balmoral Dye Notebook from 1897 stored at the Printworks Archive (Photograph courtesy of the Printworks)

Block printing had no repeat size or colour restriction. The process was only constrained by the cost of producing the blocks, creating the dyes and ultimately the time factor. Block printing was a wet on dry process;

'…wet on dry is where it prints on top of a dry colour and builds up the colour and you get a lovely bloom. You could achieve colours with block printing that you couldn't achieve with anything else'

The same year the printworks was established, engraved copper roller printing was also adopted. As Interviewee A explains;

'*When copper roller printing first started, we only had a four colour machine but they would put so many colours in with block as well…so that brought the number of colours up'*

The establishment of copper roller printing within the printworks (Figure 4.78) was important for business as it allowed mass manufacture to take place. Interviewee A describes it as the *'fast side'* of printing with about 2000 metres of fabric produced at a time to render it economical. However, from the discourse it seems it was plagued by several issues;

'*There were always problems with it. To change a pattern on a 12 colour machine took over half a day…the rollers were easily damaged and it took ages to repair them. You can imagine a tiny dint involves grinding it down, filling it and smoothing it'*

Figure 4.78 Copper Roller Printing at the Printworks (Photograph courtesy of the Printworks)

Nevertheless, Interviewee A did mention the *beauty* of the process was in the engraving.

'*The depth of the engraving can affect the shade dramatically. If you had a dark red and it was a slight scratch on the surface, it would be a light pink. However if you went deeper it would be darker'*

Even though the process was limited by the amount of rollers, each roller equalling a colour, the fact that *8-10 shades* could be achieved by the depth of the engraving did provide a wider colour range. Four rollers could achieve up to 40 shades on the fabric surface.

Interviewee A also discussed another method that the researcher had not considered during the investigation. The surface roller printer was introduced to the firm in 1846 (Figure 4.80). It was made by the same people that made the blocks. Essentially, it was a block on a roller. Instead of the wooden roller being engraved,

metal shapes were mapped out on surface of the wood and inlaid with felt (Figure 4.79). The felt absorbed the dye. The printworks machine could produce 18 colours however due to the mechanical pressure, the designs appeared squashed out. Similar to copper roller printing it was only utilized for high production. Interviewee A said;

'*You wouldn't set it up for a 5 piece order because it wouldn't be worth it'*

Figure 4.79 Surface Roller with Felt Inlay (Photograph courtesy of Printworks)

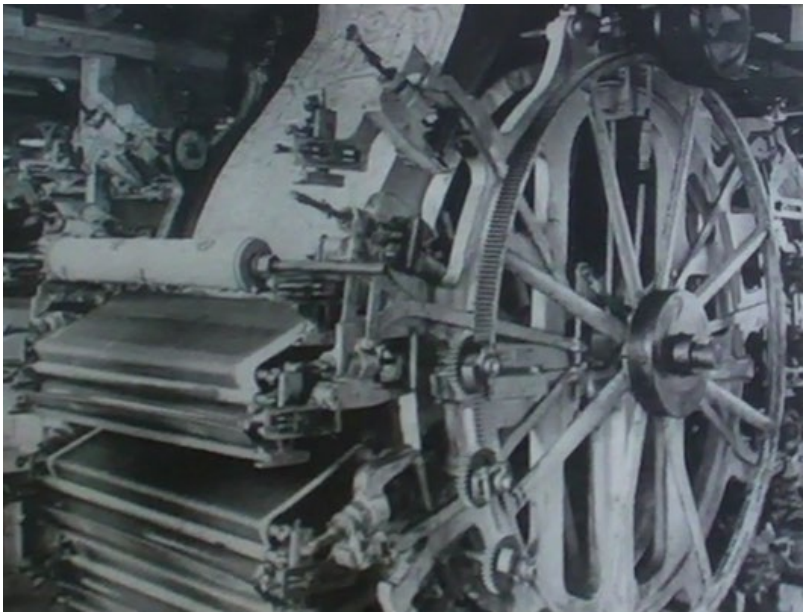

Figure 4.80 Surface Roller Machine at the Printworks, 1850s (Photograph courtesy of Printworks)

Screen-printing was introduced in 1931. Initially a hand process carried out by *'two ladies'* holding the squeegee on either side, the difference in strength could cause unevenness. By 1950, the printworks had brought in a glider system to correct this issue (Figure 4.81).

Figure 4.81 Screen-print glider system at the Printworks, 1950s (Photograph courtesy of the Printworks)

'*The screen sat in the glider frame and it ran on rollers. The (stops) marked the repeat size. As it went along, it ran along on wheels, they would lift one side up. Print one, miss one. They would go along the full table doing this. They would come back down and put back in the ones they missed out because it saved problems of wet on wet, where the screen falls on somewhere wet it would leave a bar or cause other issues'*

By the beginning of the 1960s, automatic table printers were being utilized. Flatbed screen-printing provided adequate repeat sizes. The long printing beds meant that repeat size was not an issue however; the cost of the screens was '*phenomenal*'. Rotary screen-printing was introduced in 1971. Interviewee B mentioned getting the first digital printer in 2007.

Block, copper and surface printing processes continued at the firm until the late 1970s. It was intriguing to the researcher that block printing was retained at the firm for such a long period of time after the introduction of other processes. The researcher asked about why it was kept for so long, and received a surprising answer;

'We would have kept it longer, still had a two year waiting list for orders. We had to send them to Turnbulls in Lancashire. I asked if it was possible to keep a couple of patterns on just to say we were still block printers. Others tried as well. However, the board said it was too expensive. The process was different and there

were other complications. But they just didn't want to do it anymore. Since then plenty of people have asked if we would bring it back. With digital…you don't need to now'.

It was evident to the researcher, that Interviewee A was extremely proud of the printworks history, especially with the process of block printing. Interviewee A likened it to digital printing on several occasions;

'Digital printing has gone (sound effect) full circle…from Block Printing which you could do bespoke, as many colours as you want, big a repeat as you want, it has now come back to high tech digital print'

Interviewee A had a nostalgic preference for block printing, even though he only began working for the firm in 1960.

4.9.2 The benefits and limitations of digital processes versus traditional methods

Interviewee A mentioned the amount of waste created by conventional methods;

'*Digital is straight dyes whereas conventional printing, the thickening carries the dye. In a way you're doing away with all that waste'*

Interviewee B also indicated the difference of surface (conventional method) utilizing a lot more dye as you are *'printing into the fibres of the fabric'* whereas with digital you're *'nicking the surface'*. Ultimately only placing a small amount of dye onto the surface of the fabric.

However, both interviewees were quick to point out that digital dyes are significantly more expensive. Interviewee B explains;

'For a 2 litre pack of ink, we pay £85 per colour. Dependent on the design you could use several of each colour per week'

And whereas, the more you print conventionally, the product becomes cheaper, does not function the same way for digital printing. Another disadvantage clarified by Interviewee B;

'What you can't do digitally is metallic. However can you print it digitally then print metallic rotary or flatbed?'

Nevertheless, Interviewee B clarifies other advantages to utilizing digital within the set-up already established at the printworks;

'*What you've got in digital is that you set up by the cloth. The cloth running can have 2, 3, 4 designs on it…no down time on that. Prints the first file, stops, and then prints the next file. Whereas on the printing machine, you're washing up, throwing the colour away down the drain, putting new screens in…a lot of down time from the start'*

Interviewee B has noticed a significant drop in the lengths of fabric being produced on the rotary machines. However, notes a positive of this;

'…they (printed fabrics) are premium goods. Customers will pay more for receiving 20 metres rather than 100 because they don't want to be sat on stock they won't sell'

In addition, Interviewee clarifies;

'What we didn't have in the past was a package that offered digital. We do that now. (The company) wants to be able to offer 3 rotary, 2 flat-bed and 1 digital if necessary'

Ultimately, the company is attempting to offer the best possible service for its client base, as Interviewee B explains;

'We are about the high-end, the overprint, the fall-ons, the techniques, the old style designs. Trying to give people a fantastic product from where we are and what we can achieve, whether it is rotary or flatbed or digital'

Finally, the researcher enquired about the possibility of traditional processes disappearing and being replaced by digital processes, similar to block and roller being usurped by screen previously.

Interviewee A commented;

'It's hard to say. It's similar to when we were block and copper roller printing. I was reading a report from the 1960s where they (Managers of company) were visiting different manufacturers such as Stork of Holland. They were arguing should we go into this, should we go into that. It's the same thing now'

4.9.3 The utilization of archives within the Printworks

The printworks has an archive on site as well as another archive in London.

'John Lewis owned the factory and when they sold us off during administration the archive was left here. But some of the archives went down to London.

Interviewee A, who is now retired, returns to the premises to volunteer as an archivist. The knowledge and understanding provided by Interviewee A because of his previous role within the printworks affords a unique experience. Archives worldwide are operated by knowledgeable individuals however the opportunity to discuss with someone has had first-hand knowledge is a rare occurrence. The other factor of interest to the researcher was the relaxed nature of the archive. Interviewee A was obviously very proud of history of the company but also saw the importance of accessibility. The facility had a *hands-on* approach compared to *official* facilities, which would have an expectation of preservation over utilization.

Interviewee B mentioned the importance of the archive to the work they currently undertake;

'If we can encourage the customer to use the archive, then fantastic because it brings a closer tie with the customer'

'We have a lot of digitised information. 1000s of designs from the 1980s, 1990s, 2000s. Where we could, hand separations have been scanned in and digitised'

Interviewee B also highlighted that digitising the archive is an on-going process;

'We have a lot of designs (films created by negatives and step & repeat) which are not digitised. We are being asked currently if we can digitise the information so that it can be digitally printed. It is evolving. However sometimes it's as easy to scan in the fabric and reproduce it that way'

As well as collaboration with interested parties;

'We printed 2 new designs for CAT (Centre for Advanced Textiles) up at GSA (Glasgow School of Art). They were doing a project for Lucienne Day and John

Lewis and they wanted it printed conventional. Lucienne Day's daughter came along. We printed 2 designs…Dandelion Clockwork was one of them'

The researcher made a concerted effort to ask questions related to the copyright of the archived designs. Interviewee B attempted clarified the printworks position;

'…for the archived designs. You look at the design and where it originated and where it had gone. We have terms and conditions for working with design from the archive. And it is just terms and conditions'

Confirming;

'…the copyrighted designs in the archive are just on the designs'

'…the copyright has passed on some of the designs in the archive'

Interviewee B continued to explain;

'…if we are selling it (the design) we are selling it as design inspiration rather than the actual design'

'We would do due-diligence on that design'

However, Interviewee B explained the pitfalls to copyright;

'Archivists buy old documentation from car boot sales and sell them to designers. They could sell one of our designs without our knowledge and the only time you see it is when it goes into the market place'

Ultimately the time and money it evolves to protect the design work of a specific customer is difficult. As Interviewee B explains;

'I was involved in the copyright with John Lewis and it's a minefield. Some of the designs in the archive are hundreds of years old. John Lewis didn't renew the copyright on anything because it costs money. You are not going to copyright it if you aren't using it!'

4.9.4 Utilizing the Archive

The researcher is interested in how the company currently utilizes their archives. As the printworks manufactures fabrics for a variety of different designers and brands,

this allows them to utilize the archive in a variety of different ways. As alluded to in the section above, they might sell images of designs for *inspiration.* Whereas Interviewee B implied that other manufacturers are more likely to utilize the original designs for renewed manufacture;

'...Bakers, Warners, Schumachers might have historical stuff that's within the archive. They are usually interested in the original document'

However, it was clear from the conversation that this specific printworks utilized their archive in another way. Interviewee B mentioned;

'We are currently working with Kensington Palace to do 6 rooms. We have provided information on what to look for and who to look for'

'Kensington Palace is looking at prints done for Queen Victoria in 1890. There are not many people that will have the knowledge. But we will work with them to develop something for them'

Followed by Interviewee A;

'We've done Elizabeth Gaskell's house in Manchester and Audley End Stately Home'

Interviewee B highlighted is the unique person they have in Interviewee A;

'What we have here with Interviewee A is the knowledge and history of the factory and what might have happened.'

Interestingly the Kensington Palace project linked to the utilization of digital printing, as Interviewee B clarified;

'We will probably print it digitally because it's the old look'

The researcher understood *the old look* to mean that fabrics were required to appear as they originally did. Digital printing is allowing the printworks to recreate the techniques utilized throughout history.

The findings from the Interview, Questionnaire and Sampling will be discussed further in the following chapter.

4.10 Findings from Literature

4.10.1 Designing and Fabric Printing from 1800 to modern day

The introduction of printed textiles to Europe from the Indian Subcontinent in the 18th Century had a significant impact on its technical and creative development. The preference for mechanical tools allowed Europe and America to progress the application techniques, from block printing to copper plate printing to copper roller printing to surface roller printing and then eventually to screen-printing. With each advancement in the technology came new design features that characterised a printed fabric, which provided scope for the investigation. In addition, increased production epitomised the industrial revolution. By the 1930s, screen-printing had started embracing industrial application. Originally adopted at the turn of the century by the Arts and Crafts movement in Britain as an antidote to industrialisation (Chrisman-Campbell, 2013), the Americans would realize the industrial signage application first (Lengwiler, 2013). The 1930s to 1950s era was significant for the advancement of textile screen-printing both for the manufacturer and the designer. The process provided economic value and versatility for the manufacturer compared to roller printing. In addition the designer benefitted from the opportunity for finer detail, textural qualities and a brighter colour palette (Ross *et al.,* 1990). Subsequently, the impact of the Second World War encouraged a period of revolutionary development in British textile design and process (Peat, 1993) which still resonates today. Artists and Textile Designers were supported by governmental initiatives, press publications and manufacturers to create transformative, progressive and experimental fabric design contributions (Rayner *et al.,* 2012). The ongoing legacy of these textiles can be witnessed through exhibitions such as *Picasso to Warhol: Artist Led Textiles* (2018) and the reproduction of 20th Century fabric originals by *Maharam* and *Classic Textiles*. The advent of digital technology towards the end of the 20th Century and into the beginning of the 21st Century would generate the next revolution in the printed textile industry for both designer and manufacturer. The creation of CAD software in the 1980s provided the artist or designer the opportunity for flexibility not previously available (Malik *et al.,* 2004). The introduction of digital textile printing manufacture towards the end of the 1990s stimulated interest in CAD as it provided the opportunity to render digitally created images directly onto fabric (Nimkulrat, 2016). The prospect of producing textiles with unlimited

colour palettes, unrestricted repeats and a degree of accuracy not achievable by hand has led to an explosion of design and research-led output from industry and education. These findings stimulated further exploration through attendance at exhibitions and a clearer idea of approach when visiting archival resource.

4.10.2 Scholars, educators and designers utilizing archives within design practise

Archive resources provide a storage location for the plethora of historical ephemera. Featherstone (2006) comments that the plausibility of any research is dependent on the sources utilized. By employing archive utilization within research can provide credibility to the investigation (Osborne, 1999). This approach is highlighted by several creative research projects and commercial ventures benefitting from archive utilization in the past few years. The archive was once the domain of the History Scholar, however more recently the artefacts have seduced a new type of researcher, the creative.

There is a variety of approaches utilized by designers and brands when incorporating archival resource within their creative output. The socially and politically charged offerings of Timorous Beasties (Colchester, 2007) create a *talking point*. Whereas companies such as Marks and Spenser and John Lewis delve into their back catalogues to inspire new fashion and homeware collections. M&S has even gone as far as opening a facility and devising a website celebrating its past, highlighting an interest by the company and public in accessing their heritage.

An awareness of archival utilization within mainstream design is mimicked in education through research output. Investigations at GSA have focussed on the reinterpretation of archival resource to inspire new creative outcomes enhancing the practitioners understanding of the design process (Britt, 2013, 2014). This approach has also been employed by the others including the artist, Kate Scardifield. In addition other methods include encouraging wider participation by emphasising historical significance of collections housed within archive facilities (Britt, 2014; Chappell, 2014; Briggs-Goode, 2013). Furthermore, they can be employed in the reintroduction and reinvention of historical production methods, for instance *Shadow Tissues* (Belford, 2014). There is little written about archive utilization on an industrial scale; however, British based printworks appear to advertise archive

utilization as an important component of their business structure. The literature reviewed exposed a variety of employable methods to utilizing archival resource in the execution of innovative design and investigative output.

4.10.3 Copyright Issues of utilizing archival fabrics for educational and commercial purpose

Peters (2011) states that copyright law is in place in discourage plagiarism and to encourage originality in thinking. However, it is important in design to reimagine past successes to encourage further experimentation. From a commercial standpoint, it is imperative that permission is sort before utilizing another person's artwork. The work of Classic Textiles is a good example of this. However, for educational purpose, it is possible to employ copyrighted material in a research project. This is a necessity in the utilization of archival resource from the 1930s to 1950s as the majority of it is still protected by copyright law. The opportunity to employ this resource ultimately allows the researcher to develop a deeper understanding the of the research topic.

4.11. Discussion of Findings

4.11.1 Identifying characteristics and aesthetics of printed 1930s to 1950s fabrics

Several research projects have benefitted from the utilization of archival resource. The Literature Review highlighted the ongoing investigations at Glasgow School of Art, especially the commercial venture Classic Textiles. The exhibition *Pioneers of Post-War* Pattern (2017) presented an opportunity for the researcher to gather understanding of one approach in gathering and interpreting archival data. Subsequently, this encouraged exploration of additional characteristics not visibly apparent in the textiles on display, such as dye saturation and misregistration.

Suitable resources required identification, which involved several visits to the textile archives stored at Heriot-Watt University. When it became apparent that textiles from the 1950s were limited in the facility, further online research was conducted and purchases completed. This highlighted the abundancy of readily available textiles from the era, with several sellers aware that appropriate origin identification resulted in more interest from collectors and ultimately a higher price tag. This approach allowed the handling and manipulation versus archival fabrics.

Discussions with the archivist and the wealth of paraphernalia available significantly advantaged the identification of characteristics. This combined with the researcher's knowledge base aided the process of understanding the presence of characteristics. The researcher also considered that identification could provide research potential in itself, similar to the research of Douglas (1997). The thesis examined Donald Brothers' emergence as makers of decorative cloth at the beginning of the 20th century via examination of archival fabric samples establishing the substantial contribution made to the development of furnishing fabrics during the Arts and Crafts movement.

4.11.2 Assessment of textile digital technology possibilities in the recreation of key characteristics

The potential of digital technology had been emphasised by the *Knot Knit* project. The researcher's personal experience and the literature review had stressed the importance of digital technology in the evolution of printed textiles. The researcher had already established an understanding of CAD through the utilization of Adobe Photoshop in their career so far. However, the introduction of AVA at the University provided the opportunity to explore software specifically for printed textile applications. The exploration of two digital technologies, software and hardware, provided a multitude of possibilities in recreating the characteristics highlighted in the case studies. Once the initial design had been created on the chosen software, the criteria were not developed in order of identification because they did not all have equal importance in achieving the desired outcome. The development evolution of skills on AVA and the digital printers was established as a key component in trying to achieve the key characteristics.

4.11.3 Analysis of fabric samples

Initially, the researcher considered the analysis of the fabrics could be conducted through personal analysis. A flowchart to aid assessment of samples was created. However, as the investigation progressed, informal conversations highlighted differing opinions of the characteristics achieved. A questionnaire was identified as an appropriate method of establishing a more reliable assessment of the samples.

The researcher solicited a range of individual's opinions however; concern about leading the participants with the questions posed warranted attention. In an attempt

to negate these issues, the questions utilized a broader range of terminology. Instead of identifying the 1930s to 1950s specifically, the terminology *archival, vintage, old* was utilized instead. The participants were also asked to provide explanation to their answers to gather additional understanding.

The researcher identified that certain characteristics and terminology were highlighted due to a participant's background. A textile based education or profession warranted a diverse understanding of qualities such as Print Overlay (C) or knowledge of Print Method (L). For instance Participant 4, who had a professional background in textile science, characterized several *qualities* as mistakes, faults or defects, such as the overlapping of colours. This could be due to their professional understanding. Whereas, the researcher has a different professional background as a Print Technician would describe them as characteristics as they are intended by-product of the original process. This interpretation was epitomised by participants with a design-based background such as Participant 1 and 2. Participant 8, who did not have any textile based background or profession utilized fewer descriptive terms. However, this type of response represented a wider demographic and the researcher considered that the limited timeframe had hindered the opportunity to gather feedback from a more diverse range of participants. Instead, the focus of participant selection had been aimed at people with an understanding of design.

The questionnaire emphasised an issue of personal analysis. The author had concentrated on several subtle nuances, which might only be of interest, or identifiable to someone in a specific related field. The author considered Characteristics A, B, C, E and H to represent these nuances as they appeared in limited responses or not in the original context. For instance, Question 8 highlighted that several of the characteristics applied to render the appearance of screen-print equated to respondents referring to an appearance of *contemporary, current, modern*. The researcher concluded that in attempting to render the features noticeable, they had applied significant exaggeration. The researcher considered this a drawback of digital technology. The opportunity for *uninhibited thinking* (Malik, 2004) can lead to not knowing when to halt development of a design.

The responses identified that Colour (I), Motif (K) and Misregistration (G) are the most valid characteristics to indicate *archival, vintage, old* on both Sample A and B. Fabric Choice (D) was also important, however several participants considered Sample B presented the impression of *contemporary, modern, current* due to the substrate choice. The researcher concluded that Fabric Texture (D) is difficult to imitate. This is further emphasised when utilizing digital printing, as a *filter* can only provide the appearance of a texture and not the physicality. The substrate choice of Sample A provided the tactile quality required to allude to an *archival, vintage or old* textile. Whereas, Sample B made several respondents answer to its synthetic nature even though it was printed on cotton poplin. The researcher surmised that this could be due to the flat, regimented behaviour of the substrate chosen and the technological advancement in synthetic fibres appearance. Ultimately, this highlighted that the tactile qualities of a fabric are important in recreating the characteristics of an archival fabric. In addition, Sample B elicited comments on the dye penetration on the reverse of the fabric (F) however these tended to be connected to its digital creation rather than the original intention of increased dye penetration (Briggs-Goode, 2013).

Print Quality (L) referring to the number of colours and the block shapes utilized was considered another important factor. However, the extra colours created by the additional texture (D) resulted in several participants referring to Sample B as *contemporary, modern, current.* Colour (I) is important in defining an era. However, the researcher had only considered it towards the end of sampling *Jungle.* This highlighted that the participants and researchers expectations of an *archival, vintage, old* fabric are different which links to the remark about nuance earlier.

Essentially, the questionnaire highlighted the importance of certain characteristics such as Colour (I), Substrate (D) and Print Quality (L) as being most significant. An attempt to render the qualities onto a digitally created design was undertaken. However, the combination of twelve characteristics and attempting to exaggerate the qualities (such as Hand Drawn Qualities (E) and Surface Print Edges (A)) led to the appearance of digitally rendered by default. The researcher concluded the importance of subtlety as a factor when utilizing digital tools.

4.11.4 The benefits of Archive Utilization for education and industry

The investigation identified several benefits in both an educational and industrial context. Utilizing archival resource allows for the preservation of ideas. As mentioned in the interview, block printing ceased production in the 1970s because of the high cost of production. However, the company saw the importance of retaining the archival information to develop later. From an educational angle, referring to the past permits innovative development and is a key component of many educational programmes. This topic has significant scope for further investigation which could be explored in the future.

Ultimately, without the opportunity for archival utilization it would not have been possible to conduct this investigation. The treasures of the archive can be applied for creative and research outcomes and by doing so the user is preserving and reinterpreting the memories for future generations.

CHAPTER FIVE - CONCLUSION

In answer to the original research question, *can the qualities of a 1930s to 1950s archival printed fabric be captured utilizing digital technology;* it must be answered in the affirmative. Digital textile software and hardware is certainly beneficial in capturing some of the key qualities outlined in this investigation. Digital technology provides textile designers and researchers innovative tools and *visual languages* (Nimrulrat *et al.*, 2016) to create with. Subsequently, archive utilization permits the opportunity to preserve ideas such as traditional print methods for future generations. Accessing archive resource emphasised a key consideration that it is important to preserve the past. The researcher concluded that the preservation, reinterpretation and application of historical design and artefacts is an integral part of a contemporary design process. In addition, it can be utilized for commercial gain (Classic Textiles), wider audience participation reconnecting to heritage of a place, person or era (*Lace:Here:Now*) and educational context (Britt, 2014).

The recording of previous methods requires early adoption, before the original artefact has degraded beyond recognition or the technique has disappeared from culture. It took until the 1970s before roller and block printing disappeared from industrial application, but it clear from the research that there is still a desire for this appearance in current textiles. As Participant 11 comments;

'Ultimately I am resigned that conservation will only be able to achieve its aim for so long hence your project is essential. I am pleased that this questionnaire seems to be looking at how best to deliver the whole experience with modern materials'

However, this uncovered questioning on whether it is important to preserve traditional fabric making processes. The questionnaire provided insight from a variety of viewpoints with the majority of the participants keen to retain *traditional* characteristics within design but willing to receive this via modern techniques.

In addition, the researcher considered the importance of boundaries in the application of traditional characteristics through digital means. The endless possibilities provided by digital technology can hinder the recreation of traditional characteristics from the 1930s to 1950s. The opportunity to have an unlimited colour palette and

gradients does not synchronise with the characteristics required to capture a screen-printed textile. Essentially, digital technology provides the tools to capture qualities of an archival fabric. However, it is dependent on the user's skillset to their application.

This thesis therefore concludes that the findings comprised three different contexts; personal (design/technical), educational and industrial. These distinct perspectives and broad range of analysis gained through reviewing literature, exploration of exhibitions, sampling, questionnaire and interview provided a significant amount of data and insight into archive and digital technology utilization. In establishing the original aim, it can be concluded that this thesis has determined that digital technology provides opportunities in the utilization of archives and capturing qualities of the fabrics held within, essentially *Interpreting Tradition in the Digital Age*.. The findings can be utilized for a variety of applications within design, educational and industrial contexts furthering the potential of digital technology in the preservation of our heritage. Ultimately, it highlights the importance of utilizing our past to inform our future. In simple terms, precious fabrics are behind glass in cabinets or hidden from general view in archives. However, digital technology application can produce facsimiles and reinterpretations of fabrics from the 1930s to 1950s allowing not only visual satisfaction but tactile gratification. This permits manipulation such as cutting and folding which can inform future design concepts for industrial and personal application. In addition, it provides educational and general archive user accessibility permitting original artefact preservation and opportunities for wider engagement for archive and museum facilities.

5.1 Recommendations for Further Research and Development

The research that was undertaken for this thesis has highlighted several avenues for further research. The investigation primarily focussed on a design and educational context with less focus on the industrial application. The conducted interview at the printworks emphasised the importance of their archival resource to business, whether it be for commercial activity or historical accuracy and recreation by working with stately homes and the suchlike. The lack of literature on the subject signifies future research potential. A vast amount of the resource is not currently digitally recorded for prosperity, this combined with the commercial aspect of the business and the

application of digital software and hardware opportunities provides possibility for additional investigation.

Additionally the research presents collaborative opportunities to further develop the captured characteristics into digital software tools, providing education, designers and industry the opportunity to apply the criteria automatically. For instance, this could be developed into a mobile phone *app* to automatically apply a traditionally printed fabric appearance to any surface design.

Finally, certain characteristics of the fabric such as colour and motif were touched upon but not fully investigated. There are opportunities for the development of colour and design databases specific to different eras. These could be utilized from a historical context to aid the recreation of significant artefacts or period interiors. In addition, they could be utilized by educators, designers and industry in the creation of innovative design work.

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